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MAN-POWER AND THE NEEDS OF YOUTH

FEW features of the opening weeks of the War have received more widespread approbation than the desire manifested in our general policy to conserve human life so far as possible. If loss of life is inevitable in warfare, strategy and tactics have been designed to secure objectives with the minimum of loss, and to avoid the appalling wastage which so often characterized offensives in the War of 1914–18. The announcements that the earlier age groups will not be among those first called up for service with the armed forces and that the former militiamen are not to be drafted immediately to active service units, the fundamental idea in evacuation schemes, and even the redundancy or waste in certain branches of civil defence against air attack which have been the subject of recent criticisms, are all signs that lessons of the last war are being taken to heart. It is realized that the man-power of Great Britain is a most precious national asset, and a serious effort is being made to conserve it.

Welcome as such signs may be, we cannot assume that the lesson has been fully learned. Man-power is as precious on the home front as in the field, and the uneasiness and criticism regarding the Ministry of Supply which have found expression are indications that concern exists whether the wisest use is being made of the nation's resources in labour and skill in the mobilization of industry, to meet alike the demands of the fighting services for munitions and of the myriad essential home needs of a nation at war. Even more disquieting, however, is the postponement of the raising of the school-leaving age to fifteen years, which was to have been enforced from September 1 last.

That an Act should have been passed repealing sections one to six of the Education Act 1936 cannot be viewed without dismay. A trenchant passage in the paper by Mr. W. O. Lester Smith, director of education for Manchester, which was read before a meeting of Section L (Education) of the British Association at Dundee seems now almost like a prophetic warning :

"One of the great social tragedies of our time is our blindness to the needs of boys and girls in the adolescent period when schooldays are over. The wanton blow struck at the day-continuation school clauses of the Fisher Act by the Geddes Axe was probably the unkindest cut our educational system has suffered ; it has prevented local authorities from making a decent job of the youth problem."

Mr. Lester Smith goes on to point out that, of our three million young people between the ages of fourteen and eighteen years of age, one third only attend any kind of school, another third belong to some voluntary organization, while the remaining third—probably those who need it most—are completely out of touch with educational or wholesome social influences. Mr. Lester Smith's argument is powerfully supported by Dr. A. E. Morgan's recent report to King George's Jubilee Trust on the needs of youth, where it is maintained that the raising of the school-leaving age to fifteen years is not enough. We cannot afford to let even the boy or girl of sixteen slip out of our care and allow invaluable human capital to run to waste. A system of part-time continued education carried on during the working day up to the age of eighteen years is essential.

We are indeed far as a nation from realizing the difference it would have made if the Fisher

Act had been in force in the post-War years, or how far the shock given to our social life by the disaster of widespread unemployment might have been broken. The exasperating picture drawn by the Unemployment Board of youth going to seed after a flourishing beginning followed by lack of attention need never have been; the boys and girls whose lives were blighted by the effect of those drifting years might have found help and strength in the development of their minds. Nation and Government alike have been lacking in imaginative insight where youth is concerned. So far from recognizing the cruel wrong done by our neglect, the Government is now withdrawing the only big educational gain of this generation, and there are even those whose first reaction to the need for economy in the financial sphere is to press for the further squandering of the most precious form of our human capital. The recent announcement of the President of the Board of Education that a special committee has been set up to deal with juvenile welfare is a welcome sign, however, that the Government is not entirely indifferent to the matter.

It is recognized, of course, that under war conditions administrative arrangements necessary to make beneficial use of the extra year at school would be difficult and that the difficulties have been enhanced by evacuation. To base suspension of the raising of the school-leaving age on financial grounds, however, is reprehensible and dangerous, betraying an indifference to fundamental values that may well cause alarm among all who are concerned to see that our war-time effort is prosecuted as effectively as possible. The contention that the elaborate machinery for exemptions would be unworkable in present circumstances is equally invalid. Recognition of the real value to the nation of raising the standard of education during the formative years would lead us rather to abandon all exemptions, as indeed most educational authorities recommended originally.

It is indeed idle to expect real progress until the nation as a whole is awake to the value of youth as its ultimate capital—the bedrock upon which alone, as Dr. Morgan remarks, we can lay the foundations of real national fitness. Then indeed we might have the courage to repair this evil and not intensify it. To impose compulsory continuation education up to the age of eighteen might indeed put a strain on industry at a time when the war demands all its energy. That, however, is not the whole truth. Even more than the nation needs munitions, it needs capable and intelligent human power. So far as the immediate needs of the war are concerned, it might be true economy to take all boys and girls out of industry for some hours every week for education. Any loss in material output would be more than balanced by the improvement in the men and women on whose spirit and capacity the nation must rely for victory.

If we regard, as we must, the permanent needs of the nation, the argument is more powerful still. None can say how many of the difficulties of the last twenty years are due to the destruction of talent and virtue by the last war itself, to the loss of constructive minds, imaginatively alive to the fundamental issues. But some of the difficulties are doubtless due to our persistent indifference to the nation's larger needs, our failure to strengthen the moral and intellectual power of the electorate to meet the demands made by world politics on their intelligence and imagination.

The discussion on education as a preparation for industry and on education in industry before the British Association at Dundee afforded welcome evidence that, at least in some quarters in industry, the higher standard of education demanded in the leaders of industry, as well as in the rank and file, for the successful conduct of industry to-day is now recognized. The wider recognition of the value of a sound general education is all to the good, and equally the dependence of progress upon co-operation between industry and educational authorities is gaining recognition.

It is indeed from co-operation in this way, the development of contacts between the educationist and the industrialist, and the fuller understanding of each other's point of view, difficulties and problems that we may expect an informed opinion to emerge powerful enough to resist short-sighted policies or economies on the part of the Government. Already many industrialists are alive not only to the importance of part-time continued education, but also to the importance of provision for the leisure needs of adolescents. It is for the industrialists to join hands with the educational authorities in representations against policies likely to undermine industrial efficiency and dissipate human capital.

Dr. A. P. M. Fleming's fine presidential address to Section L of the British Association, a portion of which is printed elsewhere in this issue (p. 852), strikes the right note in this crisis. Industry, he contends, is not concerned with the education of its personnel in a narrow sense only. It recognizes increasingly

that education for those engaged in industry must be characterized by broad aims and linked up with the outside world. It has proved its willingness to co-operate with education and is increasingly desirous of recruiting those well trained in fundamental principles rather than in any special branch of the selected science. It is turning its attention to the problem of finding suitable personnel trained to undertake the increasingly difficult problems of management. As this problem is solved, industry will find itself provided with leaders imbued with the realization that every industry is in fact a national service, although it may be conducted by private enterprise, and as awake to the welfare of its workers as they are to the technical efficiency of the enterprise. Such leaders will ever be vigilant against the betrayal or waste of national resources, whether in materials or in men and women. Meanwhile, it is imperative that the importance of youth as a national asset should be fully recognized, and that every effort should be made to prevent a repetition of the disastrous mistakes of the last war period in the treatment or even exploitation of youth.

PSYCHOLOGY OF WAR AND PEACE

War and Peace

Essays in Psychological Analysis. By Dr. William Brown. Pp. xvi + 93. (London: Adam and Charles Black, Ltd., 1939.) 5*s*. net.

THIS book left its author's hands a few months before the outbreak of war, and though he was sanguine enough to say that the events at Munich in September 1938 "saved the world from war at that time, and possibly for ever", yet his book does not on that account lose any of its real value. Dr. Brown is a well-known psychologist of a definitely marked type. He writes here as a psychologist on the subject of war and peace, and he would have done well if he had adhered rigidly to the scientific point of view, and avoided even distant references to his political convictions. The book would probably also have gained in weight and influence if greater care had been bestowed upon clear and consecutive exposition.

The book consists of six chapters, three of them selected from previous publications, together with a number of letters contributed to *The Times*. The author's claim that these parts in their subject-matter belong together will not be disputed, but it must be added that if they are to "fall naturally into their place as stages in the argument", the reader must to a great extent make them do so. For the most part, Dr. Brown makes himself quite intelligible to people who are not students of abnormal psychology, but the reader should be warned that, after many pages free from technicalities, he is suddenly informed that "we may cure or improve the hysteric, the psychoneurotic, but the psychotic still in the main escapes us".

We have said so much because we believe that the psychologist has an important message on the subject of war and peace, and because we are anxious that he should be understood by the ordinary intelligent citizen. Dr. Brown holds that unless the world applies psychology to its problems, as it has applied physics and chemistry, physiology and pathology, its pursuit of peace will continue to fail. His difficulty is that the man in the street thinks he knows all about psychology, as he thinks he knows all about economics—for has he not a mind of his own, and has he not much to do with credit balances and deficits? We cannot have a nation of experts, but we ought to have a far wider appreciation of the forces that make for war. Among the most fundamental of those forces are the tendencies to self-preservation, self-assertion or aggressiveness, acquisitiveness, and pugnacity. The activity of the group mind, with partial liberation of repressed mental forces, especially under the influence of a leader, also stands out as an essential factor in leading to the outbreak of war. Such are the main positions taken up and explained in Dr. Brown's book.

If we interpret Dr. Brown aright, he would say that in spite of all that has happened since this book appeared, his views remain unchanged. When the war ends, we must begin again to seek peace and ensue it, never yielding to a belief that war is inevitable. But, he holds, we shall never secure peace by orgies of pacifist sentiment. The more hopeful way is that of understanding human nature, especially those sinister forces which lurk in the unconscious of the best of us. "The tiger is there, and the wolf, and the jackal, and the snake, and we must not forget the donkey."

We conclude by expressing the hope that psychologists of different schools will do much more than has yet been done to throw light on the dark problems of war. Meantime, Dr. Brown has courageously led the way.

THE PLANNING OF LONDON

The Government and Misgovernment of London
By Dr. William A. Robson. Pp. 484. (London: George Allen and Unwin, Ltd., 1939.) 15*s*. net.

As soon as the international situation permits, there can be little question that much more time and thought than hitherto will have to be concentrated on urgent problems in home affairs, among which the government of London stands pre-eminent; and even if international affairs are still pre-eminent, that indeed may be cited as a principal reason why this matter should receive immediate and intelligent consideration, with a view to immediate and intelligent action, for it can easily be shown to be a primary factor in national defence. Dr. Robson emphasizes this aspect with convincing force, and also very appropriately at the beginning of his book insists that the proper government of London is a question of supreme national and not only metropolitan importance.

"A dim realisation is dawning on the public that the size, growth and development of London have nation-wide effects which are felt ultimately in the remote quarters of Great Britain; and many people have recently become aware of the sinister military significance of the immense concentration of population, wealth, and power in London; but so far there is little or no understanding of the connection between these matters and the general administration and planning of London government".

Again, in the last chapter, at page 459, he urges the essential need for clear recognition of the fact that London's government is a national question calling for national leadership and direction; pointing out that nothing would be more fatal than a complacent delegation of this vital and fundamental problem to the local authorities to settle among themselves.

Dr. Robson has to deplore that for half a century or more no Government has exhibited qualities of leadership, imagination, or determination in regard to this much-needed re-organization. In fact a striking, not to say an amazing, feature of the history of the metropolis during the past hundred years is the vast number of commissions and committees of all kinds that have studied, with great trouble and expense, some aspects or other of London municipal organization—or lack of it—and made excellent and desperately urgent recommendations on overwhelming evidence; but nothing whatever has been done! These pages are a record of innumerable lost opportunities, of feeble drifting, of supine indifference, and of a lack of courage and imaginative foresight that is absolutely appalling. Doubtless the opposition of vested interests, municipal or otherwise, has sometimes been exceptionally powerful and well organized; and the share of the City Corporation in this respect is not too creditable. But the true issues and their importance have been clearly realized by acute observers from the time of the first emergence of the problem, long before it reached its present huge and almost unmanageable shape. Among others it was thoroughly grasped by the Royal Commission on Municipal Corporations (second report in 1837), and by the Select Committee of 1838. In 1852 Mr. Toulmin Smith said that "the present condition of this huge metropolis exhibits the most extraordinary anomaly in England. Abounding in wealth and in intelligence, by far the greater part of it is yet absolutely without any municipal government whatever" (page 56).

Of books on London, besides innumerable Blue Books, there is no end; and several of the more important are given in the footnotes. Of planning and reform talk there has been likewise a swelling flood, and yet, as Mr. Pick, of the London Passenger Transport Board has pointed out (quoted on page 415): "Town-planning does not really exist at all in London at present. What goes by the name is almost idle and useless so far, and has not yet arrived at a conception of the congeries of towns that make up a metropolis." Elsewhere he, like many others who have seriously studied the matter, fully acknowledges the need for unified control of an aggregation of people in a single social, economic, geographical unit. "Aggregation", whilst apt enough for the present heterogeneous dismembered mass of London humanity, is not perhaps the best term for that mighty co-ordinated community which, despite political and local differences which may persist, will yet breathe as one vast organism, aflame with civic ardour, and united in one common bond of municipal loyalty. That dream of the future should not be long delayed in its realization; and it may be said at once that it does not mean that all local differences and governments will be wholly sunk and immersed in one dominating form of control.

Dr. Robson's main idea, in fact, is the establishment of a Greater London Council, which should be the one supreme authority in an administrative area very much greater than that of the present

L.C.C., and with far wider powers. It would take sole charge of certain important functions where unified control is most essential, and would exercise only supervisory powers over the local authorities in matters which should preferably be left mainly under their control. There would also be a third category of activities which could be left wholly to local control. The number of authorities, however, would be much less than the present bewilderingly numerous collection, and their respective areas would be correspondingly larger. Certain *ad hoc* bodies like the London Passenger Transport Board would doubtless have to remain, provided some means were established for the better co-ordination of their functions with the general control; but the county councils on London's borders would probably have to relinquish or abdicate their powers which, under the new arrangement, would be unnecessary and merely obstructive.

The book is a very fine piece of work, the result of Herculean labours and research of existing material, with much original and constructive suggestion of its own. It exhibits in a marked degree literary qualities of a high order, and the keen analytical powers of a trained legal mind, together with a sustained interest almost unique in studies of this kind. Interest, indeed, is intensified both by the very special and unprecedented nature of the subject-matter and by the method of treatment. There may be differences of opinion in matters of detail, but as to the main recommendations of the author there can surely be little question or quibble among intelligent people.

The difficulties in the way of reform are doubtless formidable, but that is no ground for shirking or further postponing the issue, which presses clamorously and insistently for early action. The historical background as well as the sharply critical treatment of the present muddle and confusion show clearly enough that action of some kind is long overdue.

Among the many valuable features over which one would wish to linger there is only one of which exigencies of space will allow mention: Dr. Robson continually emphasizes the paramount need for awakening the interest of the individual elector; but not content to leave it there, he suggests several ways in which this urgent need may be supplied (pages 67, 171–73, 279, 314, 324–25, 330, 351), or indicates reasons why it is lacking. To the suggestions already made perhaps one may be allowed to add another, namely, that a smaller and cheaper version of Dr. Robson's work would perhaps more effectively reach the teeming millions of London who are most nearly concerned, as well as the general public throughout Great Britain, who also must give some thought to this vital matter of the government of London.

W. G. L. C.

INTRODUCING BIOLOGICAL PRINCIPLES

Animals without Backbones

An Introduction to the Invertebrates. By Ralph Buchsbaum. Pp. x + 371 + 128 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1938.) 25*s*. net.

WHEN one reads that an attempt is being made to present a zoology text-book in "simple, non-technical language", one's first reaction is invariably that of suspicion. In the majority of cases the authors of elementary zoology text-books fall between two stools. In the desire to preserve an easy and popular approach a book often takes on a bias towards natural history, and although serving to describe the habits and characteristics of many animals, is generally lacking in morphological detail and in theoretical principles. On the other hand, in order to present the academic point of view, a book not infrequently becomes a mere compendium of technical terminology and minute detail in which fundamental issues are obscured. Fortunately (for our introductions to invertebrate zoology are very limited) this book belongs to neither of the above classes. Each group of animals is treated in such a way that it illustrates some general principle of biology or some level in the evolution of animals from simple to complex forms. In this account of the lower group of animals, Dr. Ralph Buchsbaum combines an extensive practical knowledge of the subject with that rare propensity for making the 'wood' apparent without neglecting the individual 'trees'. The sequence of the book is based on the course given to students at the intermediate grade in the University of Chicago, and the author has been fortunate in having the active collaboration of the staff of the Zoology Department there.

A particularly interesting feature of the book is the liberal supply of drawings. These, together with the numerous photographs, immediately command and later compel attention. The photographs, which are intended as a sort of laboratory

exhibit and vicarious field experience, are extremely profuse—there are ninety-eight insect photographs alone—and represent a new approach in the production of biological text-books. The drawings are original, are mostly diagrammatic and have been prepared as an adjunct to the author's attempt to expound biological principles rather than to confuse the student with meticulous attention to detail; they are generally designed to convey *ideas* about structure, function, or habit. Much of the attractiveness of the book is due to these unusual diagrams, many of which are 'three-dimensional'; a tribute by the author to his sister, Miss Elizabeth Buchsbaum, for her "skilful and artistic execution of the drawings" is richly merited.

The text contributes to that clarity of outlook which is revealed by the diagrams and photographs, emphasis being constantly placed upon the principle involved rather than upon the detail connected with it. Occasionally, with a revulsion for the use of extraneous terminology, the author carries his simplification too far; this is seen in his disinclination to use zoological nomenclature as complementary to the local name. Since the book is American, some of these local names would be quite unfamiliar to British students. There are some inaccuracies, but these are rare, and one can readily believe that this book will soon find its way to many bookshelves. That it is already appreciated is borne out by the fact that a second impression was printed just two months after the issue of the first.

T. H. Hawkins.

MANUFACTURE OF CALCIUM SUPERPHOSPHATE

Calcium Superphosphate and Compound Fertilisers

Their Chemistry and Manufacture. By P. Parrish and A. Ogilvie. Pp. xiv + 322. (London: Hutchinson's Scientific and Technical Publications, 1939.) 35*s*. net.

SUPERPHOSPHATE is one of those chemicals that are almost indispensable to civilized man and never put by him to base uses. It commands our interest for several reasons. Its value for increasing world supplies of food and fibres has been proved on all five continents, and the annual consumption of it now exceeds sixteen million tons. It was the first so-called 'artificial' fertilizer to be manufactured on a large scale, by J. B. Lawes in Great Britain, where also its use as a simple fertilizer and as a base for 'compound' manures was first developed.

Some thirteen years ago the present authors wrote a book on superphosphate to which they gave the too general title of "Artificial Fertilisers: Their Chemistry, Manufacture, and Application", and the present work is a revised and extended version of it with a more accurate title, though even this is somewhat invalidated by the added chapter on basic slag. The subject as treated will appeal to the technician, and especially to that notable example of technical 'hybrid vigour', the chemical engineer; the language, too, is technical, and the authors themselves would not claim to have produced a rigidly scientific or a literary treatise.

The bulk of the book relates to the manufacture of superphosphate, to the plant used and the operations involved in grinding and crushing the phosphatic raw material, its treatment with sulphuric acid in various types of 'den', the drying, storing, handling and bagging of the product. Conveying machinery is well described, and interesting data are given concerning the manufacture of sulphuric acid from spent oxide and the preparation of 'compounds' by mixing. Apart from the omission of several kinds of fine-grinding plant used in Britain or abroad, the mechanical part of the subject is well done; the numerous photographs and line-diagrams are particularly good, whilst the sensible treatment of financial outlay and working costs is also to be commended.

If the authors had confined themselves to the above matters, and had expressed themselves in better style, there would be nothing but praise for the book. It is no doubt owing to the lack of a clear and succinct style that they seem to tread on thin ice when they assert that "metaphosphoric acid is a product of overheating", that "pyrophosphoric acid only occurs in substances which have been subjected to heat", and that "the calcium salts of orthophosphoric acid are found in all phosphatic fertilizers. . . ." The same reason can scarcely be advanced for the surprising statement that water combines with monocalcium phosphate to form hydrated crystals of calcium sulphate. Recent X-ray analysis has shown that only a small proportion of the calcium sulphate which is present in superphosphate is in the hydrated form, so that explanations based upon the old view are now outmoded.

References to "concentrated fertilizers" are apt to confuse the reader unless he understands the difference between those based upon ammonium phosphate, like the German 'Nitrophoskas' and the English 'Concentrated Complete Fertilizers' (C.C.F.'s) that were first marketed in 1926 and 1930 respectively, and the projected new concentrated fertilizers that are based upon superphosphate. The authors' sweeping statement that "in the early trials the concentrated fertilizers were found less efficient than the compound manures, and their use began to decline after a few years" needs correction. Apart from a few isolated failures, mainly with the American 'Ammophos' and with 'Nitrophoska' in the United States about ten years ago, the early trials, conducted on strictly scientific lines, were very successful. Sales of Nitrophoska increased spectacularly until the world depression in 1931, when they fell, but have gone ahead since, whilst sales of C.C.F.'s have increased continuously and markedly from the start.

Few of those who know the requirements of British crops and soils will dispute the authors' opinion that there is still scope for the greater use of fertilizers, but the suggestion that the fertilizer industry, and in particular the superphosphate industry, should be better represented in Parliament opens up, by implication, a vista of trade representation and commercial flag-waving in that august assembly which would be entirely foreign to its honoured traditions.

THE STEAM ENGINE AND ITS DEVELOPMENT

A Short History of the Steam Engine

By H. W. Dickinson. Pp. xvi + 255 + 11 plates. (Cambridge: At the University Press, 1939.) 15s. net.

THIS is the most important work on the history of steam engines published since 1908, when Dr. C. Matschoss's "Die Entwicklung der Dampfmaschine" appeared under the auspices of the Verein Deutscher Ingenieure. But whereas Dr. Matschoss's work ran to two volumes each of more than 700 pages, and dealt with all types of engines, including locomotives and marine engines, Dr. Dickinson's book is on a much smaller scale, and is devoted entirely to stationary engines.

As is well known, Dr. Dickinson spent some thirty years as a keeper at the Science Museum, London, and the catalogue of stationary engines, containing information about more than five hundred exhibits, was prepared by him. But he is no dry-as-dust compiler and is as interested in the lives of inventors and in industrial progress as he is in the machines themselves. In this volume he has therefore been able to incorporate the results of the researches of such as Mr. Rhys Jenkins into the early history of heat engines, the results of his own inquiries into the lives of Boulton, Watt, Trevithick and others, and a general review of boilers, engines and turbines since the steam engine began to revolutionize industry in all its ramifications.

There are fourteen chapters in the book, of which five deal with the work done in the seventeenth and eighteenth centuries, four with the progress of boilers and the reciprocating steam engines during the nineteenth century, and four with modern boilers and steam turbines. There is also a chapter on the philosophy of the steam engine. In addition, there is a reproduction of a synopsis of events in the history of the steam engine exhibited at the Science Museum, and a good index.

Though in a brief notice it is not possible to touch upon the many interesting developments in steam machinery set out in the book, many readers, we think, will find entertainment in the excellent account given by Dr. Dickinson of the Newcomen engine, which proved of such outstanding value and importance. Belidor, the celebrated French engineer and architect, said in 1739 of this engine that it was the most marvellous of all engines: "Heat is its principle of movement; in its various pipes it creates a circulation like that of blood in the veins, having valves which open and shut opportunely; it feeds itself; it discharges itself at regulated times and draws from its own work all that it needs to subsist". No less marvellous are the boilers and turbines found in the power houses of to-day, and the end is not yet.

To all the developments of the last 200 years a whole host of ingenious men have contributed, and in his well-balanced, impartial and authoritative review, Dr. Dickinson has endeavoured to do justice to all those who made contributions of outstanding merit. The portraits given in the book are those of Papin, Smeaton, Watt, Evans, Trevithick, de Laval, Rateau, Parsons, Curtis and Ljungström. These were the pioneers of the reciprocating engine and of the turbine; but between these groups of pioneers were scores of notable inventors to whose labours attention is directed in the text. Altogether this history should prove a most useful book.

ONE HUNDRED YEARS OF MICROSCOPY

The Royal Microscopical Society

By Prof. R. Tanner Hewlett

THE Microscopical Society of London, now the Royal Microscopical Society, was founded in 1839, and it was proposed to celebrate its centenary this October with a special meeting. This function has been postponed for the present, but papers on the progress of microscopy during the last hundred years, contributed to celebrate the occasion, will be published in ensuing numbers of the Society's *Journal*.

In the earlier part of last century, microscopy was beginning to attract considerable attention, and not only among men of science, for public exhibitions with the microscope were given in London about 1833. This development owed much to improved instruments and to improvements in the lenses about this time. The first English achromatic lenses for the microscope were made by Tulley, an instrument maker of Islington, in 1825, at the instigation of a Dr. Gurney. Then in 1830, J. Jackson Lister, father of Lord Lister, devised improved formulæ for "working [achromatic] object glasses of short foci and large aperture, with a view to increase the power and ease of manufacture", and his paper did much to stimulate the production of better microscopes and their more extended use.

In 1839, several votaries of this new science of microscopy lived in Wellclose Square, near Tower Hill, including J. S. Bowerbank, authority on sponges, N. B. Ward, of "Wardian glass-case" fame, Edward Newman, the entomologist, and the brothers Edwin and John Quekett, whose name is perpetuated in the Quekett Microscopical Club. These and several others met at Edwin Quekett's house on September 3, 1839, and on a proposal by Bowerbank decided to form a society for "the promotion of microscopical investigation, and for the introduction and the improvement of the microscope as a scientific instrument"—aims which it has always been the endeavour of the Society and its fellows to fulfil. In December of that year, the Society came into being, with Richard Owen as its first president, Ward as treasurer and Dr. Arthur Farre as secretary. J. J. Lister was one of the original members, and Michael Faraday joined in 1841 and remained a member until his death. The Society was incorporated by Royal Charter in 1868, during the presidency of James Glaisher, and the reigning Sovereign has since been its patron.

Owen delivered his presidential address in February 1841, on "The Structure of Fossil Teeth from the Old Red Sandstone indicative of a new Genus of Fishes (*Dendrodus*)". Of the roll of eminent men who followed Owen as presidents of the Society may be mentioned John Lindley the botanist, Thomas Bell and George Busk, zoologists, W. B. Carpenter, John Quekett the histologist, W. Kitchen Parker, H. C. Sorby the spectroscopist, Lionel Beale, W. H. Dallinger, E. M. Nelson, C. T. Hudson, Lord Avebury, Sir Ray Lankester and Sir J. Arthur Thomson.

During the first forty years of its existence, the proceedings of the Society were published successively in certain journals, but since 1878 the Society has issued its own *Journal*, which in addition to its proceedings, contains abstracts of the world's literature on microscopy. The Society maintains an extensive library and a cabinet of more than 20,000 representative microscopical specimens, including many 'type' specimens of diatoms and other forms of minute life. It also possesses a unique collection of historical instruments.

The following brief survey of communications appearing in the Society's *Journal* will serve to give some idea of the contributions made by fellows to microscopy, though representing but a fraction of the matter contained therein. Reference to articles by living fellows, which have appeared during the last few years, is also omitted, with one or two exceptions.

Dealing first with the microscope and its accessories, an outstanding achievement was the formulation in 1858, with subsequent revisions, of a standard screw-thread for objectives, now universally adopted by makers all over the world. As a result, an objective by any maker will fit the nose-piece of any microscope. The Society has likewise drafted specifications for the sizes of eye-pieces and sub-stage fittings which have been generally adopted.

In 1854, F. H. Wenham contributed a paper on "The Application of Binocular Vision to the Microscope", and described his binocular microscope, and J. W. Stephenson described his "erecting" binocular microscope in 1870. T. Maltwood in 1858 designed his "finder" for registering the position of objects mounted on a slide, and the description of the construction of an iris diaphragm was given by J. H. Brown in 1867. A malachite-

green cell for monochromatic illumination was described by J. W. Gifford in 1894, and the glass-rod illuminator by J. W. Gordon in 1907, and Keith Lucas in 1904 designed a stand in which geometric slides replaced the usual planed ones.

Numbers of papers are to be found on microscopical optics, to which E. M. Nelson made notable contributions, and about 1879 the question of lens-aperture and of microscopical resolution occupied much attention, and numerous papers were devoted to these subjects. In that year, Abbe defined "numerical aperture" as we now understand it, and stated that for immersion purposes cedar-wood oil had proved the most suitable fluid.

In 1865, Huggins and Browning first dealt with the application of the spectroscope to microscopy, and later H. C. Sorby contributed much to microspectroscopy, incidentally, in his presidential address to the Society in 1870 surmising the possible existence of "invisible germs", thus anticipating by some thirty years any positive knowledge on ultra-microscopic organisms.

There are naturally many contributions on photo-micrography, commencing with a paper "On the Application of Photography to the Representation of Microscopic Objects" by Joseph Delves in 1853.

As in the "brass and glass" department, as we irreverently call it, so a vast amount of material has been contributed on the biological side. Diatoms, presenting as they do problems in the interpretation of the microscopical image, and as being a most interesting group, both fossil and living, have always been a favourite subject of study, and are dealt with in numerous papers by Wallich, Greville, Kitton, Petit, Flögel and others. The Foraminifera have also been much studied; early papers on the group were contributed by T. Rupert Jones, and more recently by H. B. Brady and F. Chapman, together with the notable papers by F. M. Millett on Malay forms, and by Heron-Allen and Earland on the Selsey, North Cornwall, North Sea and other species. Rotifers are likewise the subject of numerous papers by C. T. Hudson, P. H. Gosse, V. Gunson Thorpe, James Murray, C. F. Rousselet and others. T. H. Huxley contributed a study of the rotifer *Lacunularia socialis* in 1853.

The Infusoria are dealt with by Saville Kent, C. T. Hudson, Dallinger and Drysdale and Dallinger. The latter, in 1880, determined the thermal death-point of monads in natural surroundings to be for the mature forms about 140° F. Dallinger in 1887 also worked on the gradual acclimatization of certain monads to increasing temperatures, and was able finally to maintain them without harm at a temperature of 155° F. E. M. Crookshank and H. G. Plimmer dealt with parasitic flagellated Protozoa. The mites are the subject of a number of papers by A. D. Michael, which deal with their structure and taxonomy and with new species, and Rupert Jones wrote on the Entomostraca and Saville Kent on siliceous sponges.

Parasitology is represented by several communications, commencing in 1849 with one by George Busk on the guinea-worm parasite of man. He remarked that infection is derived from water and that the worm is always female in its attributes; statements that stand to-day, for even now the male is almost unknown.

On the botanical side, contributions on the Bacteria are relatively scanty, probably because microscopy is rather subsidiary to culture methods for their study. There are, however, papers by R. L. Maddox on bacteria in the air and in rain-water and hail, and on lactic ferments, by E. M. Crookshank on Actinomyces and by Cheshire and Cheyne describing *B. alvei*, supposed to cause foul brood of the honey bee. In 1884 Lionel Beale described the microscopical examination of twenty-five samples of Thames mud, taken between Gravesend and Chelsea, for the presence of bacteria, determining their relative numbers at the various localities, and he remarked that if only the vast quantities of water in the upper Thames in time of flood could be husbanded for times of scarcity, there would be ample water to flush London's sewers and to keep the lower Thames from being fouled—surely a presage of the later work of the Metropolitan Water Board.

Many new micro-fungi were described by G. Massee, and other papers on this group were contributed by Miss Lorrain Smith and A. Chaston Chapman. Freshwater algæ are dealt with in many papers by A. W. Bennett and W. and G. S. West, and the bog mosses by R. Braithwaite. There are also many papers on vegetable structure, pollens, cytology and chromosome structure, and W. Carruthers and D. H. Scott dealt with the microscopical anatomy of fossil plants.

There are a goodly number of papers on animal histology, notably by John Quekett, Lionel Beale and C. da Fano, and W. Kitchen Parker contributed several studies on the development of the skull in birds, etc. In 1849, R. Warington described a new medium for mounting organic substances as permanent microscopical objects; this was glycerin, and he outlined the method of sealing the mounts with various varnishes. R. J. Farrants, president in 1861–62, devised the well-known Farrants' mounting medium.

There is no space to record many other important contributions, particularly those on the technical applications of microscopy to iron and steel, clays,

petroleum, fabrics and fibres, and others, and to medical science. Many of the subjects referred to in this account are discussed more fully in the papers contributed in honour of the Society's centenary, which, as mentioned, are to be published in the Society's *Journal*.

In conclusion, we may express the belief that the Royal Microscopical Society has throughout its history sedulously pursued studies associated with problems of microscopic structure and function, and has contributed in no small measure to the development of the microscope as a scientific instrument, and to its applications in science and industry.

EDUCATION FOR INDUSTRY*

By Dr. A. P. M. Fleming, C.B.E.,

Metropolitan-Vickers Electrical Co., Ltd.

THE evolution of industry involves a continual change in the character of the knowledge that must be applied by those engaged in it, if they are to achieve a continually increasing efficiency of production. How important this question of efficiency is to the whole community of an industrial nation may not always be appreciated. The material progress of civilization demands an increasing supply of manufactured products of all kinds. If they are manufactured at home, employment is increased and money is available for circulation. This affects eventually all the community and not merely those workers directly engaged in industry. It is therefore of vital importance that the transformation we speak of as industry shall be conducted with the utmost efficiency, and to achieve this the personnel engaged in it must be most effectively trained; which in its broadest sense means most effectively educated.

Industrial personnel can be divided into two main groups: manual and non-manual workers. The first requirement of the manual worker is practical handicraft skill, and of the non-manual worker specialized knowledge applicable to the function he performs in the particular branch of industry concerned. To satisfy these requirements well-organized schemes of theoretical and practical training must be made available to all those fitted to take full advantage of them.

There are four main classes of entrants into industry, namely, those who enter at the school-leaving age from elementary, junior technical, central and secondary schools; those from secondary schools who have attained School Certificate or Higher School Certificate standard; those who have had university training; and those adults who enter at any age and from any educational level. Of the first three classes, the university group contains the smallest proportion of misfits. At the lowest entry level, economic need and local conditions of employment may, and usually do, determine the choice of vocation. In addition, there is still considerable social prejudice in favour of the so-called 'black-coated' occupations. The importance of vocational guidance in the early years cannot be too highly stressed, and although good work is being done in this direction much more is needed; it should in fact be accepted as a responsibility by every competent teacher. Such acceptance implies, of course, familiarity with local conditions and opportunities. One useful adjunct might be the keeping, from school entry age onwards, of a record of the particular characteristics, aptitudes and preferences displayed by the pupil. Such a record would be of considerable value at the time when discrimination is made between secondary, junior technical and junior commercial schools.

For those entering industry at the lowest stage there is, at present, little conscious preparation for industry from the educational point of view other than that in the junior technical schools. The practical industrial bias given in these schools, for at least the final two years, is of definite advantage. A much greater proportion of junior technical school pupils who enter industry advance rapidly than is the case with their fellows not so educated. Indeed the tendency is for many of them to be recruited to the ranks of foremen, junior managers, draughtsmen and so on, with the result that the equally important field of artisanship is not very well fed numerically from this source. Records of one factory, compiled over a period of years, show that whereas 64 per cent of the entrants from elementary schools became artisans, less than 10 per cent of the entrants from junior technical schools did so, in the same period.

The type of industrial training required for the manual worker who aspires to learn a trade or acquire a craft consists of a long period of practical

* From the presidential address to Section L (Educational Science) of the British Association, delivered at Dundee on August 31.

experience with the tools, materials and processes of his chosen trade or craft, and accompanying classroom education which may be secured by evening study in a local part-time institution, by part-time day training, or in a works' school during working hours. The character of these studies varies considerably, but it is becoming increasingly desirable that they should lead to National Certificates, as a course of this type provides sufficient basic technical knowledge. Moreover, it provides a good basis for further study for the youth who is worthy of promotion.

For those youths who do not aspire to technical employment and whose natural bent is of a more practical character, the workshop courses provide an admirable adjunct to their practical experience.

Those who enter industry at the School Certificate or Higher School Certificate level have usually had the advantage of a preliminary science preparation, which facilitates their acquisition of industrial process experience. Moreover, their higher general educational level makes it possible for them to attain staff positions where their more maturely developed powers of judgment and their social attributes are of advantage.

Those who enter after university training have already acquired a considerable amount of knowledge of the technological and fundamental principles required in the particular branch of industry they select. A high degree of specialization at this stage is extremely undesirable. It is of far greater value to be well versed in the fundamental principles of the selected and associated subjects. Indeed the latest tendency in industry is for any specialized training that may be required to be provided by the concern itself a year or two after entry.

Much attention is now being devoted to the problem of finding suitable personnel trained to undertake the increasingly difficult problems of management. This is a matter of vital importance in ensuring continuity of progress in manufacturing concerns. It is essential that the selected men should be given preliminary and widely applied responsibility before making use of such aids as the ancillary instruction now available in many technical institutions.

Recruitment for research work in industry is another case where the selection of personnel inherently suited for such work must be the basic factor. Methods of training research workers are beginning to evolve, but so far no recognized plan is established. In my own laboratories, general apprenticeship in the factory is followed by experience in several of the laboratories under the guidance of experienced research workers, supplemented by lectures on the work in their own and associated fields by senior members of the department. In some cases such workers are sent back to a university or other research laboratory for further experience.

There is a natural tendency to concentrate attention on those engaged in some form of handicraft skill or technical operations for which particular education and training are required. It must not be overlooked, however, that there are vast numbers of young men and women engaged in clerical and other branches of employment in industry. For the most part, however, their education and training can be adequately satisfied by the existing facilities.

The normal trend of industry and its corresponding educational requirements can to some extent be forecast, though contingencies arising from an abnormal international political situation may disturb this.

New scientific knowledge with its technical application is likely to continue to be a determining factor in industrial development. Continual improvement in efficiency of production tends to reduce the amount of labour required, and to that extent accentuates the unemployment problem. On the other hand, out of scientific discoveries new products, processes and materials arise, and these, through the formation of new industries, contribute towards redressing the balance of employment. The film and the radio industries may be cited as examples of large-scale employment brought about by the technical application of scientific discovery. Such developments, however, emphasize the need for mobility and adaptability on the part of the personnel employed, because new industrial activities demand modifications to established handicraft technique as well as to the planning and organization of production.

It is apparent that the mechanization of processes, more particularly where repetitive work is involved, will become more extensive, and this should ultimately result in the securing of the necessary volume of production in shorter working periods—especially if employment could be more evenly distributed. Some of the time then available for additional leisure might be well employed in education of a cultural and social character and in physical training. By suitable planning it should be possible to reduce and eventually to eliminate the system of part-time evening study. The deficiencies of this system of technical education for those engaged in industry are well understood, but whether technical study is conducted in part-time day or part-time evening periods, the practice of compressing a large amount of highly specialized knowledge into intensive courses should be avoided.

While appreciating the present usefulness of courses such as those leading to the Higher National Certificate, particularly to those young people who have no other means of acquiring the basis on which to proceed to technical employment, such courses should, in a planned educational system, be considered as expedients only. They provide neither the time for original, critical, or constructive thought, nor the means of developing latent personal qualities by any form of social and corporate life; and above all it is important to encourage educational methods which develop ability to think independently rather than simply to add to a store of knowledge. That so many young people succeed by the existing methods is a tribute to the individual rather than to the system.

Certain industrial activities, notably those associated with supplies such as water, gas and electricity, are easily recognizable as public services. As time goes on there will be a growing realization that every industry is in fact a national service, although it may be conducted, as at present, by private enterprise. Considered in this light, the importance of employing every means of increasing the efficiency of industry becomes apparent. The conventional system of education is subject to control by national and local educational authorities; but there is no control over the equally important practical side of education for the industrial worker. No national means exist whereby a standard can be set for this phase of education, nor in fact are the resources for training in industry fully utilized.

The *laissez-faire* methods whereby the quality and extent of practical education of industrial personnel depends on a relatively few progressive industrial concerns compare unfavourably with the planned and more efficient methods that are possible in authoritarian countries. Under present conditions this weakness can be remedied only by more complete voluntary co-operation within industry. Such co-operative effort would relieve the burden that now falls upon a few individual firms. An effective way of stimulating this might be the remission of income tax on the money expended on such training. Control could be instituted by restricting the remission to courses approved by a suitably constituted authority.

The establishment in industrial firms of separate 'nursery' workshops in which the fundamentals of handicraft skill and machine operations are taught concurrently with the appropriate workshop instruction will become more widespread. A few schemes of this type are already in operation in private firms and in a number of Government establishments in Great Britain, while the method has been extensively developed in Germany and to a lesser extent in other countries.

The result of introducing manual training at an early age, such as exists in the educational system in the U.S.S.R., will be watched with much interest. In contrast to this, with the raising of the school-leaving age, the tendency in Great Britain will be for young people to enter industry for practical training at progressively increasing ages. This may involve a more intensive period of practical training, but the difficulties of this should be offset by the greater maturity of the trainees concerned, which the longer period of general education will ensure.

An educational problem that is already acute and will be even more so in the future is the supply of suitable teaching staff for the universities and technical institutions. Formerly much of the scientific and technical development relating to industry came from the universities. Due largely to the establishment of large-scale research by industrial concerns and to the great expansion of their technical staffs, the initiative in progress has passed to industry, and many scientific workers who previously found their vocations in academic life are now attracted to scientific and technical employment in industry. The result is that in those faculties in which the work has a technological bearing, there is a great shortage of personnel available for teaching, so that the time is opportune for the technical institutions and universities to consider a long-term policy as regards selecting and training those who will eventually become the academic leaders.

The practical industrial side of this training is of paramount importance. In this connexion co-operation should be arranged with industry to provide a suitable range of practical experience without the permanent absorption of the personnel so trained. Industry has already shown its willingness to co-operate with education in this respect by providing short 'refresher' courses for those in academic employment who have little opportunity of maintaining close contact with industrial developments. The technical knowledge and experience of eminent technologists in industry might well be utilized more completely than at present by co-opting such men to the professorial staffs of universities and technical colleges, and thus augmenting, for special courses, the existing teaching facilities. New technical processes now arise so rapidly from scientific discoveries and become so promptly established in industry that the text-books used for teaching purposes can never be completely up to date. The introduction of post-advanced courses in the Lancashire area appears to be the correct solution to this problem. These courses, which comprise short series of lectures on specific technical subjects, are given mostly by experts in industry and are conducted on a basis of exposition and discussion.

The greater availability of technical scholarships and fellowships might well serve as a means of attracting suitable personnel to industrial employment. The extension of fellowship facilities available for those who seek experience abroad is extremely valuable, particularly if these are awarded to men who have already had sufficient experience to know definitely in what particular directions they wish to supplement their existing knowledge. In the past, many educational opportunities of this type have not been used to the best advantage due to the immaturity of those receiving the awards, who have not had sufficient experience to appreciate fully that educational and industrial methods can never be transferred wholly from one country to another because social and economic conditions differ. Some industrial organizations have established research fellowships, whereby university staffs can spend time in industrial research organizations, which provides experience of inestimable value to the fellowship holder on his return to academic life.

As yet there is no clearly defined and assured path by which a youth can proceed through the various stages of education into industrial employment. The national system of education provides the means whereby those of suitable ability can obtain education and training up to and including the university or technical college level, but the practical training in industry and an assured start in a job is at present fortuitous. In this direction there is room for greater co-operation by industry to ensure the completion of the industrial training and a start in the chosen career. Such an arrangement would give direction and impetus to the various stages of preparation between school or college and industry, would cut down some of the time spent in obtaining what may be unnecessarily detailed technical knowledge, and moreover would relieve both the youth and his parents of a good deal of anxiety.

Greater co-operation than at present exists between education and industry is essential in regard to the syllabuses of workshop and technical studies appropriate to the educational level at which entrance into industry is made. Equally also, co-operation in needed to ensure the adequacy and up-to-date-ness of the laboratory and workshop equipment of the technical institutions and universities.

In this address I have purposely stressed the technical aspects of education for industry, since these to a considerable degree serve also as a basis for the industrial education of the personnel in those branches of industry not directly of a technical character. In so doing I am acutely conscious of the risk that, speaking as an industrialist, I may convey the impression that industry is concerned with the education of its personnel in a narrow sense only. This is far from being the case. All education should be on the most liberal lines, and even to meet the urgent needs of industry no technical specialization should be permitted which excludes the possibility of time being devoted to broadening the mind and equipping the individual to play his part most worthily in the community in which he is placed.

GAS PRODUCERS FOR MOTOR-CARS

THE appearance on a road in the London district of an omnibus with a trailer carrying a gas-producing apparatus to provide gas as fuel for its engine is a spectacular event which marks an important stage in mechanical propulsion in Great Britain. Although the method is by no means new, its adoption, even if only on an experimental scale, by a responsible authority on one of its public services, raises it from the category of the practically neglected to a position as one of the recognized possible alternatives to the use of liquid fuel. The trailer is not an essential part of the apparatus, and as soon as practical details have been settled by experience it will be possible to embody the gas producer in the vehicle so as to constitute a self-contained unit; but in the case of the existing pattern of omnibuses there is no surplus space in which such an apparatus can be placed. In the case of the private car or delivery van, there is usually room for the required size of gas generator and little difficulty need be experienced in mounting it and its accessories quite conveniently.

In the issue of NATURE of May 6, p. 771, some notes were published on a paper read before the Institute of Fuel by Goldman and Clarke Jones entitled "The Modern Portable Gas Producer" (*J. Inst. Fuel*, 12, 63, Feb. 1939). The authors argued in favour of official recognition of portable gas producers as a means of supplying power for motor-vehicles. Now, nearly twelve months later, the argument for recognition is greatly strengthened, for economists have assured us that transport is the life-blood of modern conditions. Yet now transport is greatly restricted and, for lack of petrol, many cars have

been laid up indefinitely or their use limited. The possibilities claimed for this new method of power production, therefore, deserve fuller examination, and, as the fuel is home-produced, those who require a greater degree of use of their cars can consider its adoption. In our earlier article, the process of gasification was described and readers may now wish to have information regarding the British-made apparatus referred to in the paper.

This plant has been successfully mounted on private cars of medium power, on transport and other vehicles, and is so designed as to require no special skill on the part of the driver. A supply of fuel is dropped into a hopper placed above the generator, where a moderate fire is maintained and a gas of high calorific value produced. The gas is cooled by the air going to the generator, to which some steam is also supplied in order to keep the temperature below the ash fusion point, thus eliminating a possible source of trouble. On its way to the engine the gas is passed through a cleaner to remove dust. Photographs reproduced in the paper show the complete apparatus as fitted to a Humber car, a Bedford lorry, and to a tractor hauling a plough, and in each case the addition has been effected without inconvenience or unsightliness. The first lighting of the fire—a matter of no great difficulty—takes ten or twelve minutes, and it does not require to be relit afresh each day. The hopper is charged occasionally with fuel, and this can be done without stopping the engine.

Suitable fuels, such as anthracite or one of the low-temperature cokes—for example, coalite—although abundant, are certainly not so conveniently obtainable as was petrol in ordinary times. This difficulty would be overcome, but in any event users could easily store ample supplies if the authorities granted permission. As regards operating costs, the claim is made that the advantage lies with the gas producer. On the basis of the prices of a year ago, the total operating costs for a 1½-ton vehicle making a weekly round of 600 miles would be £11 10s. per week when petrol is used and £9 17s. in the case of the gas producer. It may therefore be seen that the system is practicable and not necessarily expensive.

Official approval of a form of gas producer was conveyed by an announcement made by the Secretary of Mines in the House of Commons last week. He said that the Government, recognizing that in time of war it is clearly in the national interest to make the best possible use of home-produced substitutes for imported oil, had some time ago set up a committee to consider the problems of such gas producers. As a result, not only has the use of producer gas been sanctioned, but concessions have also been made to ensure that users do not suffer disadvantage in making the change-over.

OBITUARIES

Prof. A. A. J. de 'Sigmond

IT is with great regret that we record the death of Prof. Alexius A. J. de 'Sigmond, professor of agricultural chemistry and technology and soil science in the Royal Hungarian Palatine-Joseph University of Technical and Economic Sciences of Budapest, and formerly director of the Royal Hungarian Institute of Chemistry and Central Experimental Station at Budapest. Coming of an old aristocratic Transylvanian family, he found himself at the end of the War of 1914–18 compelled to choose between his work which lay in Hungary or his estates which were in the country ceded to Rumania. He decided for his work.

To English men of science de 'Sigmond was best known through his investigations on the alkali soils in Hungary, which he described in publications of the Imperial Bureau of Soil Science and the University of California Press. Although there were certain special features about these soils, he had carried out his researches on broad lines, which made the results particularly interesting and helpful to those engaged on soil improvement, reclamation, and similar problems in many other parts of the world, especially the semi-arid regions. His other important branch of study was soil classification, which he dealt with at length in his book on soil science; this was written in Hungarian, but in somewhat abbreviated form it was translated into English by Dr. Yolland under the title "The Principles of Soil Science". His classification had the double merit of being comprehensive and based on the chemical composition of the soil: it was not intended to be final, but it satisfactorily filled a number of gaps in other systems. It has not been universally adopted, nor indeed has any as yet; but it represents a distinct addition to knowledge on a very difficult and important subject.

Prof. 'Sigmond was a regular attendant at meetings of the International Society of Soil Science, of which he was an honorary member, and he was always a welcome guest in any international group by reason of his wide linguistic abilities and broad sympathies. He was a man of great personal charm and artistic taste; he was very fond of music; and altogether a good type of the cultured aristocracy of central Europe now unhappily fast disappearing, to the great loss of our civilization.

E. J. Russell.

Dr. J. D. Comrie

Dr. John Dixon Comrie, a well-known Edinburgh physician and medical historian, whose death took place on October 2, was born on February 28, 1875, the son of Dr. J. D. Comrie. He was educated at George Watson's Academy and the University of Edinburgh, where he qualified M.B. with first-class honours in 1899, becoming F.R.C.P. (Edin.) in 1906 and M.D. in 1911. After holding resident appointments at the Edinburgh and Glasgow Infirmaries, he attended post-graduate courses in Berlin and Vienna, and was clinical assistant at the National Hospital, Queen Square, London, before settling in practice at Edinburgh, where he successively became pathologist, assistant physician and full physician to the Royal Infirmary as well as consulting physician to the Deaconess Hospital and the Princess Margaret Rose Hospital for Crippled Children, Fairmilehead, Edinburgh. During the War of 1914–18 he was consulting physician to the North Russian Expeditionary Force, with the rank of Lieutenant-Colonel, R.A.M.C.

Dr. Comrie's literary output was considerable. In addition to his principal work entitled "The History of Scottish Medicine", of which the first edition appeared in 1927, and the second, enlarged to two volumes, in 1932, he contributed many articles on medico-historical subjects to the *British Medical Journal*, *Edinburgh Medical Journal*, *Archiv für Geschichte der Medizin* and the *Proceedings of the International Society of the History of Medicine*, at the congresses of which he was a well-known figure. In recognition of his valuable work on medical history he was appointed reader in the history of medicine in the University of Edinburgh, honorary fellow of the Italian Society of the History of Medical Science, and president of the Section of the History of Medicine at the meetings of the British Medical Association at Edinburgh in 1927 and Winnipeg in 1930.

In addition to his original work and his consulting practice, Dr. Comrie was frequently engaged in an editorial capacity, being editor of the Edinburgh Series of Medical Text-books, the selected works of T. Sydenham, Black's "Medical Dictionary", and since 1938 of the *Edinburgh Medical Journal*. His unfailing courtesy and kindness endeared him to all who knew him and particularly his co-workers, by whom he was elected vice-president of the Royal College of Physicians of Edinburgh, chairman of the Scottish Committee of the British Medical Association, and president of the Royal Medical Society of Edinburgh.

J. D. Rolleston.

Dr. Walther Horn

The death of Dr. Walther Horn on July 10 last in his sixty-eighth year removes a familiar personality from the world of entomology. Although essentially a worker in taxonomy who held very definite views on its principles, his interests covered a wider field, and he worked for the good of entomology as a whole.

A very regular attendant and contributor at international congresses, Horn became personally known to a wide circle of European and American entomologists. For nearly fifty years he was a student of the Coleoptera, becoming the world authority on the family Cicindelidæ. A few years before the War of 1914–18 he became director of the newly founded Deutsches Entomologisches National-Museum in Dahlem, and devoted great energy in bringing it up to its present status and efficiency. The Museum suffered a severe setback by the advent of the War. Horn was called up for military service and, in this period, he exercised his original profession of a doctor. During the supervening period of inflation, the funds of his Museum dwindled away, and it was only by his untiring courage that things were kept together. By soliciting small sums from his friends in other lands, and by taking advantage of favourable monetary changes, he gradually acquired the means of saving his Museum from ruin. In 1921 its character underwent change and its name was altered to that of the Deutsches Entomologisches Institut, with affiliation to the Kaiser-Wilhelm Gesellschaft in Berlin. Its primary function became bibliographical rather than the maintenance of collections.

At the time of his death, Horn, in collaboration with Dr. Hans Sachtleben, edited three periodicals which were extensively used as a medium for procuring current literature for the Institute by way of exchange. During 1935–37 the publication of Horn's "Entomologische Sammlungen" was a notable effort wherein he recorded the history of all scientifically important insect collections from the time of Linnæus onwards.

Horn's singleness of purpose, coupled with wide travel, linguistic ability and cordiality towards men of all nations, made him many friends. He was able to free himself from some of the binding force of national limitations and, thereby, played a part in promoting international amity among co-workers that will be hard to replace.

A. D. Imms.

We regret to announce the following deaths:

Dr. Arthur P. Beddard, chairman of the Pharmacopœia Commission, formerly lecturer in medicine in Guy's Hospital, London.

Prof. R. A. Craig, professor of veterinary science in Purdue University, an authority on the diseases of pigs, on October 12, aged sixty-seven years.

Mr. J. A. Fulton, director of the Mackay School of Mines of the University of Nevada, on October 9, aged sixty-one years.

Prof. H. O. Knight, professor of anatomy in the University of Texas, an authority on the anatomy of the hand and foot, on October 5, aged fifty-eight years.

Dr. R. A. Sampson, F.R.S., astronomer-royal for Scotland during 1910–37, formerly professor of mathematics and astronomy in the University of Durham, on November 7, aged seventy-three years.

NOBEL LAUREATES

Prof. R. Kuhn

Prof. Richard Kuhn, who has been awarded the Nobel prize for chemistry for 1938, is Viennese by birth and a pupil of Willstätter. He has been head of the Department of Chemistry of the Kaiser-Wilhelm Institut für Medizinische Forschung in Heidelberg since the Institute was opened in 1930, and, after the death of von Krehl, was made director of the Institute in 1937. Kuhn's work does not consist of one single great achievement, although he has made important contributions to many problems in organic and biochemistry. His early work was concerned with enzymes and with stereochemical problems. He has done important work on the polyenes, of the general formula $C_6H_5(CH=CH)_n C_6H_5$, which he was able to synthesize up to $n=15$. It was thus possible to gain information on the behaviour of long chains of conjugated double bonds, which are also of interest in other fields of work such as photographic sensitizers.

Kuhn has also worked out the synthesis of a new class of chemical compounds, the cumulenes. This work led up to a synthesis of vitamin A, which was preceded by investigations on the constitution of carotene. He recognized at about the same time as O. Warburg that the prosthetic group of a yellow ferment which is responsible for the degradation of sugar phosphoric acid esters is present in vitamin B_2. With the synthesis of lactiflavine-5′-phosphoric acid, he achieved the preparation of the active group of an enzyme. Through the application of boric acid in the condensation with alloxan, he was able to increase the yield up to about 90 per cent of the theoretical value. His most recent work is concerned with the chemical nature of sex substances necessary for the copulation of gametes of various algæ. Specific carotinoids, such as crocin and *cis*- and *trans*-crocetin-dimethylester, are essential for the mobility of the Protozoa under anærobic conditions and for the process of copulation. Prof. Kuhn is well known in Great Britain, and he delivered the sixth Pedler Lecture of the Chemical Society in 1938, when he discussed the synthesis of polyenes.

Prof. A. Butenandt

Prof. Adolf Butenandt, who shares this year's Nobel prize for chemistry with Prof. L. Ruzicka, is well known in Great Britain. For a number of years Prof. Butenandt held the position of *Privat Dozent* in the Department of Chemistry of the University of Göttingen under Prof. A. Windaus. There can be little doubt that his association with this laboratory, the work of which had been devoted to the elucidation of the structure of the sterols for so many years, played an important part in his success in determining the constitution of œstrone. It was while he was at Göttingen that Aschheim and Zondek made their classical discovery of the presence in the urine of pregnancy of large quantities of œstrogenic material. It was found to be in a purer state and more subject to processes of purification than when extracted from the ovaries or follicular fluid. The large-scale commercial collection of this material in Germany rendered available in 1928 quantities of starting material. To Butenandt fell the task of elucidating the structure, and in 1929 he succeeded in obtaining the compound in a crystalline form.

The announcement was made simultaneously with that of the independent discovery of a crystalline material by Doisy in the United States. Marrian in Great Britain had also obtained a crystalline substance, but it was found later to be of a different constitution from the crystals of Butenandt and Doisy. The work of Butenandt on the selenium treatment of œstrone resulted in the demonstration of the presence of the phenanthrene ring system, and a classical paper on this was communicated to a meeting of the Chemical Society held in London in March 1933. Later Butenandt worked on the constitution of the male sex hormone. He isolated androsterone in the crystalline form and proved its constitution, and his work on progesterone and other derivatives of the sterols forms the background of this important development in chemistry. He left Göttingen to take the chair at Danzig, and was for a few years professor of chemistry in that University. Some two years ago he was appointed director of the Kaiser-Wilhelm Institut of Biochemistry in Berlin, which position he now holds. Many of our readers will remember the three lectures Prof. Butenandt delivered at the London School of Hygiene and Tropical Medicine in 1936, lectures which were noted for their clarity of style and for their excellent delivery in faultless English.

Prof. L. Ruzicka

Prof. L. Ruzicka, professor of chemistry in the Federal Technical Highschool of Zurich, has a long record of brilliant investigations in the field of pure organic chemistry. Without doubt, however, the present award is mainly on account of his development of the degradation synthesis of hormones from sterols. It will be remembered that the workers at Göttingen devoted many years to the elucidation of the structure of the side-chain of the sterols, it being well known that these could be removed by appropriate chemical treatment. The recognition of the structure of progesterone, testosterone, corticosterone and other highly active hormones of the steroid group led organic chemists to attempt their synthesis. The formidable nature of this task will readily be appreciated, since not only is the cyclopentenophenanthrene system, with double bonds, polar groups and so on, an extremely difficult object for synthetic

attack, but also there is an almost infinite number of stereo-chemical isomers due to the presence of cyclohexane rings. It occurred to Ruzicka that the ring system of the sterols might provide the basis for the synthesis of hormones, and he therefore chose a sterol with a suitable stereo-chemical configuration for the ring system and removed the side chain by oxidation. This provided a most important basis for the synthesis of the hormones, and by suitable manipulation of double bonds, conversion of hydroxyl groups to keto groups, and so on, it was possible to produce from a neutral sterol such as cholesterol the highly potent hormone testosterone. It can be said that the recognition of this principle has solved the problem of hormone production, quite apart from its great theoretical interest. Prof. Ruzicka has been a frequent visitor to Great Britain; his addresses are noted for their clarity and for their wit.

Prof. E. O. Lawrence

The announcement of the award of the Nobel Prize for physics for 1939 to Prof. E. O. Lawrence, professor of physics in the University of California, Berkeley, will be received by physicists everywhere with approbation. Lawrence's early researches were concerned with photo-electric effects but, in 1930, he became interested in the possibilities of using the method of resonance acceleration in order to obtain positive ions of very high energies, by means of a number of consecutive accelerations through relatively low differences of potential. The method of linear resonance acceleration was pushed to its practical limit in Lawrence's laboratory when, in 1934, mercury ions were obtained having energies equivalent to accelerations through a potential difference of nearly three million volts, using, however, applied potential differences having a peak value of only 79,000 volts. The limitations of the method of linear resonance acceleration in its application to the acceleration of ions of small atomic mass had, however, been recognized by Lawrence in 1930, in which year he proposed a modification of the method for such ions. This consisted in accelerating the ions back and forth between two semi-cylindrical hollow conductors, the paths of the ions being rendered circular by means of an intense magnetic field. Thus was conceived the magnetic resonance accelerator, or cyclotron as it is now more generally called.

At that time, it was somewhat generally considered that the practical difficulties involved in the cyclotron were of a magnitude likely to preclude the translation of this conception into terms of practical physics. All the greater then, was the tribute to be paid to the experimental genius of Lawrence when, little more than a year later, he announced the success of the method in obtaining light ions of high energy. His success was acclaimed on both sides of the Atlantic, by the awards of the Comstock Prize of the National Academy of Sciences in 1937 and, in the following year, of the Hughes Medal of the Royal Society, the latter being given for "the most important instrument of physical research since the C. T. R. Wilson expansion chamber". Later, however, Lawrence's interest turned rather towards the vast field of physiological research to which the cyclotron, with its prolific output of radioactive indicators, had opened up a new approach. Important results in nuclear physics continued to pour from the Radiation Laboratory at Berkeley, but at the same time a new side was being developed, and the physiological effects of neutrons and the metabolism of phosphorus and iron, and of like elements which could be obtained in a radioactive form, were being exhaustively studied. Not to Lawrence's laboratory alone was this work confined, his generosity providing for scientific workers in many places in America and in Europe as much radioactive material as they could conveniently use. Lawrence is not only a respected director of a research laboratory but, above all, a valued friend of those who have worked with him.

The 1939 Nobel Prize for literature has been awarded to N. Frans E. Sillanpää, the Finnish novelist. His novels are based chiefly on the peasant life of Finland. The Nobel Prize for Physiology and Medicine for 1938 was awarded to Prof. C. Heymans, and that for 1939 to Prof. G. Domagk (Nature, November 4, p. 777).

NEWS AND VIEWS

Royal Medals of the Royal Society

His Majesty the King has been graciously pleased to approve the recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year as follows: Prof. P. A. M. Dirac, F.R.S., Lucasian professor of mathematics in the University of Cambridge, for the leading part he has taken in the development of the new quantum mechanics; Prof. D. Keilin, F.R.S., Quick professor of biology and director of the Molteno Institute in the University of Cambridge, for his contributions to biochemistry and entomology, in particular for his demonstration of the part played by cytochrome in the oxidation reduction mechanisms of the living cell, and for his studies of the higher Diptera.

Centenary Celebrations in New Zealand

In December 1642, Europeans first discovered New Zealand, although they mistook its general character. A century and a half later their mistake was rectified by Captain Cook. His reports attracted

traders and whalers, but lawlessness, arising from "the absence of necessary laws and institutions", led, a hundred years ago, to bringing the islands under the sovereignty of the Queen of England. It is the centenary of this event which New Zealand began to celebrate last week when a great exhibition was opened at Wellington. It is fitting in a new country that prominence should be given to the natural resources of the country, forests, farm lands, and minerals, and to the means which have led to their exploitation, of which the development of methods of transport has been pre-eminent. Two thirds of New Zealand's land is now 'occupied', for the most part not by great landowners but by persons holding less than 320 acres. It is these European settlers who have developed the resources of their country in such a way as to minimize the disadvantages of isolation from the great consuming centres of the world. Happily the economic exploitation of the country has not been accompanied by a disappearance of the native people, for the sixty thousand Maoris live in friendly co-operation with the Europeans and enjoy full social and political equality. This successful experiment in State-building will be worthily celebrated in New Zealand throughout the coming year, and it must be a matter of regret that the war, which has, once again, brought out the loyalty of the Dominion, should have prevented more active participation in this event by citizens from other parts of the British Commonwealth.

Politics and Academic Qualifications in Germany

Restrictions on academic freedom in Germany, already sufficiently stringent, are to cut more deeply still into the roots of intellectual development. According to the Berlin correspondent of a Copenhagen newspaper, quoted in *The Times* of November 13, the German censorship will see in future all scientific works written for doctors' degrees. This, it is said, is intended to guard against the introduction of theories offending against Nazi doctrines in politics, law, literature, and the population policy. In view of the distorted interpretation of certain scientific and historical facts which alone is acceptable officially in Germany to-day, it might be thought that any further bar to research or freedom of thought would scarcely be necessary to render any approach to originality innocuous. In order, however, to ensure that orthodoxy, or at least what is regarded as such, shall prevail over any attempt at a scientific and dispassionate examination of fact, which might lead to conclusions at odds with officially approved conclusions, decision as to the fate of any given thesis will not rest with an academic body, which at least might be expected to bring a trained and instructed intelligence to the examination of the bearing of an argument and the value of its evidence, but with the censorship. No thesis will even be submitted for scientific examination until it has passed the censor. Regimentation thus strikes at the very root of intellectual development and scientific training. These must no longer be concerned with the search for truth in the investigation of the facts of Nature and history in both the broad and narrower sense, but only with the fanatical application of a selective theory dictated by political prejudice.

Horrocks's Observation of the Transit of Venus

Three hundred years ago on Sunday, November 24 (O.S.), 1639, the young Lancashire curate Jeremiah Horrocks, and his friend William Crabtree, the one at Hoole, near Preston, and the other at Broughton, near Manchester, observed the transit of Venus across the sun's disk, and thus, as Robert Grant said, "did two young men cultivating astronomy together in a state of almost complete seclusion in one of the northern counties of England enjoy the privilege of witnessing a phenomenon which human eyes had never before beheld and which no one was destined again to see until more than a hundred years had passed away". At Broughton the sky had been overcast most of the day, but fortunately cleared just in time for Crabtree to see the transit. At Hoole, Horrocks had watched from sunrise until his duties called him to church. At 3.15 p.m., when again free, he resumed his observations, when, as he wrote, "Oh most gratifying spectacle! the object of so many earnest wishes, I perceived a new spot of unusual magnitude, and of perfectly round form, that had just wholly entered upon the left limb of the sun, so that the margins of the sun and the spot coincided with each other, forming the angle of contact." Owing to the approach of sunset, he was unable to observe the planet longer than half an hour, but during this period he measured its distance from the sun three times. His younger brother Jonas at Liverpool was prevented from seeing the transit on account of cloud.

Horrocks, in 1639, was about twenty-two years of age. The son of a farmer, he was born at Toxteth Park, Liverpool, and was taught the classics by a country schoolmaster. He was already "a very curious astronomer" when on May 15, 1632, he entered Emmanuel College, Cambridge, as a sizar. Three years later he left the University without taking a degree, but at home he again began his astronomical observation. Through the antiquary Christopher Towneley (1604–74) he began to correspond with Crabtree, his senior by about seven years, and they became fast friends. At the suggestion of Crabtree, Horrocks abandoned the study of Lansberg for that of Kepler, and set about revising the Rudolphine Tables. Early in 1639 he became curate at Hoole, and there made his calculations regarding Venus. Having set down his observations in a manuscript entitled "Venus in Sole Visa", he resolved to visit Crabtree. Three letters dated October 3, December 12 and 19, 1640, referred to this intended visit, and it was on the back of the last that Crabtree wrote that his friend had died on January 3, 1641, being the very day previous to that he had planned for the visit. Crabtree appears to have survived him a very short time. Owing to the Civil War, the name of Horrocks was for the time completely forgotten, but his manu-

script, with others, had been preserved and was ultimately published. Nearly two centuries passed before any memorial was raised to him whom Herschel called "the pride and boast of British astronomy". In 1826, however, the Preston astronomer and lecturer Moses Holden (1777–1864) devoted the proceeds of a lecture to the erection of a tablet to Horrocks in St. Michael's Church, Toxteth, Liverpool; in 1859 a memorial chapel and window were added to Hoole Church; and after the transit of 1874 a movement was set on foot which resulted in the placing within the monument to Conduitt, Newton's nephew, in Westminster Abbey, of a scroll recalling the great achievement of Horrocks in 1639.

August Kundt (1839–1894)

On November 18, the centenary occurs of the distinguished German physicist August Adolph Eduard Eberhard Kundt, the successor of Helmholtz at Berlin. Born at Schwerin, Mecklenburg, he studied at Leipzig under Hankel, Bruhns and Neumann, and at Berlin under Encke and Förster, first devoting himself to astronomy. Entering the laboratory of Magnus, in 1864 he graduated with a thesis on the polarization of light. He became a *Privat Docent* in Berlin in 1867 and then was successively professor of physics at Zurich Federal Technical Highschool (1868), at Würzburg (1870), and at Strasburg (1872), where he took a prominent part in the organization of the new university; of this he became rector in 1877. Finally, in 1888, he was chosen to succeed Helmholtz in the chair of experimental physics and as director of the Physical Institute at Berlin. He died at Israelsdorf near Lübeck on May 21, 1894, a few months before Helmholtz. His original researches were mainly in the domains of light and sound. By an ingenious method he was able to determine the velocity of sound in various gases. In light, he made inquiries into the problems of anomalous dispersion by liquids and vapours and by very thin films of metal. 'Kundt's phenomenon' is the rotation observed, under the influence of magnetic force, of the plane of polarization in certain vapours and gases. For his experiments on dispersion by metal films he made no fewer than 2,000 prisms prepared by electrolytic deposition upon platinized glass.

Prof. Georges Dieulafoy (1839–1911)

Prof. Georges Dieulafoy, a celebrated Paris physician, was born on November 18, 1839, at Toulouse, where his uncle, Paul Dieulafoy, was professor of clinical surgery in the medical faculty and induced him to become a doctor. After acting as his uncle's house surgeon for two years, he went to Paris to complete his education and spent seven years as hospital resident under Trousseau, Velpeau, Denonvilliers, Jaccoud, Potain, Axenfeld and Tardieu. He qualified in 1869 with a thesis on sudden death in typhoid fever. In 1872 he became an assistant professor (*agrégé*) with a thesis on contagion, and the following year published a medico-chirurgical treatise on the diagnosis and treatment of morbid fluids in which he described the aspirator to which his name has been given. In 1880 appeared the first edition of his famous "Pathologie de médecine interne", which in the course of thirty-one years went through sixteen editions and was translated into English, Italian, Spanish, Russian, Polish and Greek. Six years later he was appointed to the chair of internal pathology at the Necker Hospital, where he remained until 1896, when he succeeded Germain Sée at the Hôtel Dieu as professor of clinical medicine; he held that office until his retirement in 1909. During this period he published a number of clinical lectures in six volumes under the title of "Clinique médicale de l'Hôtel Dieu de Paris". In 1910 he was elected president of the Academy of Medicine, of which he had been a member since 1879. His death took place on August 16, 1911, at the age of seventy-two.

The Newcomen Society

The annual meeting of the Newcomen Society was held on November 8, when Col. C. E. Davies, secretary of the American Society of Mechanical Engineers, was elected president for the ensuing year. Col. Davies for many years acted as corresponding honorary secretary in the United States for the Society. The annual report referred to a further large increase in membership, the total number of members on October 1, 1939, being 1,252. Twenty-five papers were contributed during the year, while in England a summer meeting was held in Suffolk and in the United States a pilgrimage was held in Alabama. For the information of members a *Newcomen Quarterly Bulletin* is now published. The finances of the Society continue to remain in a satisfactory state and the issue of a fifth *Extra Publication* is under consideration. Though for the time the monthly meetings have been suspended, papers are being sent in for the *Transactions*. At the close of the business, the retiring president, Mr. W. A. Young, read his presidential address on "Thomas Newcomen —Ironmonger: the Contemporary Background", and Dr. T. E. Lones read "A Précis of Metallum Martis and an Analysis of Dud Dudley's Alleged Invention".

Statistics of London

The latest volume of "London Statistics," that for 1936–38 (London: P. S. King and Son, Ltd., 15*s*. 6*d*.) raises once more in an acute and realistic form some of the most vital and interesting questions in social science and economics and in practical statesmanship that we of the present generation have to face. Among them not the least significant are those concerned with population movements to and from the London area and within that area. The population of this Greater London increased during 1937 by 80,000, and numbered 8,655,000 before evacuation, as compared with 7,000,000 for New York. This huge total is about double that of the administrative county over which the L.C.C. has partial control and from which there has been continuous migration since 1901. In that year the population of the administrative county was 4,536,267,

but it has steadily declined, so that in 1938 it was 4,062,800. This has involved among other things difficult readjustments in educational facilities, especially elementary schools; for the decrease in elementary school children from 900,000 in 1915 to 543,000 in 1937 is very much greater proportionately than that in the total population. In this connexion it is interesting to note that, of the 50,000 children leaving elementary schools in 1937, 89 boys and 127 girls were described as of "super-normal" mental condition.

THE subject chosen in this volume for special analysis is libraries. In the year ended March 31, 1938, 40,116,733 books were issued to borrowers from public libraries in Greater London, and 20,175,088 from libraries maintained by local authorities in extra-London. In addition there were 2,078,559 issued from public libraries in extra-London under county council control. In the administrative county alone, issues of books have risen from 14,512,112 in 1928 to 19,941,654 in 1938, the number per registered borrower increasing from 29·3 to 31·1. For some reason or other, Woolwich heads the boroughs in respect of reading—as measured by use of public libraries—whilst St. Pancras is at the bottom of the list. Readers have 2,431,832 books from which to choose, and they borrow three novels for every non-fiction work.

Recent Comets

AN I.A.U. telegram from Copenhagen announces that Comet Faye has been discovered by Jeffers at Harvard on November 3 at 4h. 1m. U.T. Its position is given as R.A. 20h. 13m. 28·3s., S.Dec. 10° 18′ 15″, and it is described as diffuse with central condensation. In the "Handbook of the British Astronomical Association", 1939, the elements and ephemeris of this comet have been computed by Messrs. W. P. Henderson and P. J. Harris, who applied the perturbations of Jupiter and Saturn. Perihelion passage is given as April 23, 1940, but it will be apparently half a day later. A comet was discovered by Frien at Harvard on November 4 at 13h. 30m. Its position is given as R.A. 16h. 52·9m., N. Dec. 34° 03′. The daily motion is +7m. 30s. in R.A. and −10′ in Dec. It is described as diffuse without central condensation or nucleus. Nothing is stated about its magnitude.

Engineers' Study Group on Economics

AN emergency programme to meet the difficulties occasioned by the war has been issued by the Engineers' Study Group on Economics. Consideration of the problems which followed the War of 1914–18 has led to the view that, while the first effort must be directed towards winning the present war, attention must be given in good time to plans for reconstruction, so that practical proposals may be ready when required. The Group has accordingly resolved to make a special study of reconstruction, dealing particularly with such problems as demobilization, industrial change-over, agricultural changes, international trade, paying for the war, etc. Those interested are asked to communicate with the Group at 35, Gordon Square, London, W.C.1.

Announcements

THE annual Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered on November 28, at 2.30 p.m., at 21 Bedford Square, W.C.1, on "Charity and the Struggle for Existence", by Dr. R. R. Marett.

THE Tilden Lecture of the Chemical Society will be delivered by Dr. L. E. Sutton on December 14, at 2.30 p.m. in the Society's rooms. The title of the lecture will be "The Present State of Valency Theory".

A PAPER on the "Penetration of Rays through the Skin and Radiant Energy for the Treatment of Wounds" will be read by Sir Leonard Hill, at the Royal Society of Arts, on November 22 at 2.30 p.m. Applications for tickets should be made to the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

THE following have been elected officers for 1940 of the Mineralogical Society: *President*, Mr. Arthur Russell; *Vice-Presidents*, Prof. C. E. Tilley, Dr. W. Campbell Smith; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Dr. G. F. Claringbull; *Foreign Secretary*, Sir Thomas H. Holland; *Editor of the Journal*, Dr. L. J. Spencer.

THE following appointments and promotions have recently been made in the Colonial Service: C. B. Johnston, chemist, Department of Science, Barbados; F. H. Ormerod, agricultural superintendent, Gold Coast; V. D. Van Someren, zoologist, Central Veterinary Research Institute, Kenya; H. B. Waters, director of agriculture, Kenya, director of agriculture, Gold Coast.

MR. G. M. HARVEY, deputy electrical inspector of mines, has been appointed electrical inspector of mines, with effect from November 1, in succession to Mr. J. A. B. Horsley. Mr. Horsley is undertaking special duties for the Mines Department during the war, more particularly in connexion with the organization of the electrical supplies required for the working of mines and quarries. He will also complete, so far as possible, the work in connexion with the revision of the existing code of safety regulations for coal mines.

THE Geological Society of London announces that the eighteenth session of the International Geological Congress, which was to have been held in London during July 31–August 8, 1940, is postponed indefinitely.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 869.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Investigation of Cosmic Ray Showers of Atmospheric Origin, using Two Cloud Chambers

USING two simultaneously operated cloud chambers, we have investigated the occurrence of large cosmic ray showers originating high in the atmosphere[1], and the transition behaviour of these showers in absorbing material. The cloud chambers were 28 cm. in diameter with an illuminated depth of 4 cm. (chamber I) and 8 cm. (chamber II) respectively. The counters used to select showers and so to operate both chambers were all situated around chamber I, there being none around chamber II. The whole apparatus was situated beneath a light roof.

In the first experiments, chamber II was placed at horizontal distances of 5½ m. and 19 m. from chamber I, and observations over a period of 250 hours were made at each separation. The frequency with which showers selected by the counter array at chamber I extended to the distant chamber II is shown in Table 1. The third and fourth columns give the rate at which showers reaching the stated particle density in *both* chambers were observed. Portions of a single shower are thus frequently to be found over a distance of 5½ m., but to a much smaller degree over a distance of 19 m.

TABLE 1. CHAMBERS SEPARATED 5½ M. AND 19 M. HORIZONTALLY

Shower density (No. of particles per 100 cm.²)	Chamber I (rate per hr.)	Chambers I and II simultaneously (rate per hr.)	
		5½ m. apart	19 m. apart
> 1	0·39	0·069	0·025
> 3	0·177	0·024	0
> 6	0·082	0·012	0
>10	0·049	0·004	0
>20	0·020	0	0

TABLE 2. CHAMBER II 120 CM. VERTICALLY ABOVE CHAMBER I

Material between chambers—(i) 36 cm. aluminium, (ii) 3 cm. lead; running time of experiment—(i) 278 hr., (ii) 182 hr.

Particles in lower chamber (I)	Number of photographs			
	Aluminium		Lead	
	Total	5 or more tracks in top chamber	Total	5 or more tracks in top chamber
> 2	143	12	131	11
> 5	85	10	75	9
> 10	41	5	40	6
> 20	12	3	10	3
> 40	2	1	4	1
>100	1	1	1	1

Particles in lower chamber (I)	Percentage of showers in lower chamber associated with 5 or more tracks in top chamber	
	Aluminium	Lead
> 2	8 per cent	8 per cent
> 5	12 ,,	12 ,,
> 10	12 ,,	15 ,,
> 20	25 ,,	16 ,,
> 40	50 ,,	25 ,,
>100	100 ,,	100 ,,

In a second series of experiments, chamber II was placed vertically above chamber I at a distance of 120 cm. Absorbing layers of (i) aluminium (36 cm.) and (ii) lead (3 cm.) were placed immediately above the lower chamber (I), and the relation between

A DENSE SHOWER UNDER 36 CM. ALUMINIUM WHICH HAS DEVELOPED FROM A LARGE ATMOSPHERIC SHOWER. THE SEPARATION OF THE TWO CLOUD CHAMBERS IS MORE THAN 1 METRE

atmospheric showers detected in chamber II and the shower phenomena in chamber I was investigated. Table 2 shows the extent to which showers of a given size below the absorber are the result of entrant showers with a certain minimum particle density. For both aluminium and lead, the largest showers result from fairly dense groups of particles entering at the top of the absorber. The average multiplication taking place for atmospheric showers in these thicknesses of material is small (about twice), and so we may conclude that the dense parts of showers have almost reached equilibrium.

Experiments by Nie[2] have been interpreted[3] as evidence for the occurrence of large showers in light materials by an explosive process. We find, however, that both in lead and in aluminium the large showers are the product of only a slight multiplication of pre-existing shower groups. The relative frequency of such showers in lead and aluminium will depend largely on the size distribution and energy spectrum of the incident showers. Little is yet known of these factors, but it is clear from the small average multiplication involved, and from the form of the cascade spectrum in air, that large showers will be relatively much more frequent in the light elements than is indicated by the cascade theory applied to a single entrant particle.

The photograph shows a portion of a large shower below 36 cm. aluminium derived from a large atmospheric shower above the absorbing layer. We estimate that the complete shower contains at least 40,000 particles, and so has a lower limit of energy of 10^{13} e-volts.

A. C. B. Lovell.
J. G. Wilson.

Physical Laboratories,
University of Manchester.
Oct. 10.

[1] Auger, Maze and Grivet-Meyer, *C.R. Acad. Sci.*, **206**, 1721; **207**, 288 (1938).
[2] Nie, *Z. Phys.*, **99**, 453 (1936).
[3] Euler and Heisenburg, *Ergebn. exakt. Naturwiss.* (1938).

Evaporation of Mist Particles and its Bearing on Air Sterilization

During the determination of particle size distribution in various germicidal aerosols, a qualitative correlation was noticed between the biological activity and the persistence of the droplets in the field of the ultra-microscope. The instrument was therefore adapted for the determination of evaporation rates; the disappearance of a selected particle was followed by successive measurements of its fall under gravity, its position being restored after each by a screw which displaced the cell contents upwards. Provisions were also made to follow the particle throughout its wanderings in the horizontal plane. It was then possible to watch a single particle for an indefinite period limited only by its complete disappearance or by physical fatigue in the observer.

A number of phenolic germicides have been examined, in solution both in polyhydric alcohols and non-hygroscopic solvents, such as water and benzyl benzoate.

For the most part, droplets of the binary mixtures examined behave like pure substances in giving a straight-line relation between velocity of fall and time[1,2,3], and therefore between surface area and time, over the greater part of their lives. For example, resorcinol-water mixtures appear to evaporate at a constant rate $\left(\frac{ds}{dt} = \frac{\delta \text{ surface area}}{\delta \text{ age}} = \text{const.}\right)$ which is independent of the concentration and also of the initial particle size over a range 5–50 per cent resorcinol, 0·5–2·5 μ radius. But it can scarcely be taken that such mixtures evaporate at constant composition irrespective of what this is, and, in fact, improved technique has shown that it is not necessary to assume this; in many cases it has been possible to observe a very rapid initial evaporation during which an unknown amount of the solvent is removed, and even with such a high boiling solvent as benzyl benzoate, this phase is complete in about ten seconds when it contains as much as ten per cent of a solute of volatility similar to its own. Generally, the change in slope of the evaporation curve is so large and so sharp that there is nothing indefinite in the division into stages. The second stage in the evaporation follows the straight line law already mentioned $\left(\frac{ds}{dt} = \text{const.}\right)$, and when the particle has become quite small, there may or may not be a slowing up, according to the volatility of the solute or the presence of impurity. (But there are many anomalies in behaviour at this stage; for example, 5 per cent glycerol in water (weight in weight) particles evaporate completely according to the straight-line law down to a radius not greater than 0·05 μ.)

As a result of the initial stage in the evaporation, it is not generally possible to estimate the composition of particles when they are under observation, and with volatile solvents it may be remotely different from that of the parent solution. Ternary mixtures behave in a more complicated way, and by observations over a range of initial concentration and of droplet size, it is sometimes possible to deduce qualitatively the changes in concentration on evaporation of mixtures of this type. Thus particles of resorcinol-glycerol-water mixtures having radii less than 1 μ after passing the initial stage begin to lose more resorcinol than water, and this continues down to a very small size.

It is found that solutions of phenols in a relatively inactive solvent like benzyl benzoate have a mist persistence which is anti-parallel with the volatility of the solutes, whereas with hydroxylic solvents this is not always the case, and the anomalies are put down to chemical association between the substances present.

Bacteriological experiments have been carried out by workers in the biological section of these laboratories on the solutions which we have examined, and we are grateful for permission to quote their results.

It was evident from the start that the germicidal activity of a mist is far more dependent upon the volatility of its particles than upon their Rideal-Walker value. Experiments with highly volatile substances, such as phenol, confirmed Bechhold's contention[4] that their vapours are generally inactive against bacteria in suspension; only when the amount of germicide atomized was more than enough to saturate the available air space was any kill obtained.

Germicidal mixtures of phenol and volatile solvent only were roughly divided into three classes.

(*a*) Highly volatile solute: No kill observed unless the air is saturated with respect to the germicide. Effect dependent on vapour pressure, and not on Rideal-Walker value.

(*b*) Volatile solute: A kill occurs over a short period, after which no further effect is obtained unless the air is saturated. Effect dependent on Rideal-Walker value to a large extent, since all the kill must take place in the limited life of the droplets.

(*c*) Involatile solute: Almost independent of Rideal-Walker value (for example, 50 per cent calcium chloride, in water, Rideal-Walker value less than 0·05, gives a better result than phenol when dispersed). The lethal effect extends over a very long period, and some effect is noticeable at enormous dilutions (greater than $2{\cdot}5 \times 10^{10}$ c.c./gm. in one case) with a fine mist, if sufficient time is allowed.

These classes correspond roughly to the three stages of a typical complete evaporation curve.

It is hoped that a more detailed report of this work will shortly be published.

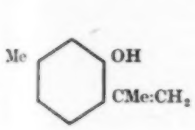
Portslade Laboratories, Ltd.,
South Street,
Portslade.
Oct. 12.

S. R. Finn.
E. O. Powell.

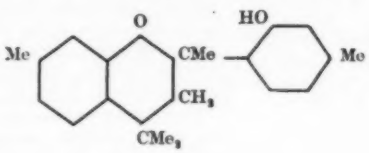
[1] Beibl, *Ann. Phys. Chem.*, **7**, 888 (1883).
[2] Morse, *Proc. Amer. Acad. Arts and Sci.*, **45**, 363 (1910).
[3] Langmuir, *Phys. Rev.*, **12**, 368 (1918).
[4] Bechhold, *B.P.*, 472,623.

Structure of the Dimeric Forms of *o*-*Iso*propenylphenols

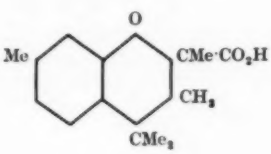
o-Hydroxy*iso*propenyl compounds, for example (I), readily polymerize to dimeric forms on long standing or on treatment with hydrogen chloride[1]. These dimerides can be distilled under diminished pressure and are generally resinous at ordinary temperature, but they yield well crystalline *mono*acetyl derivatives, and contain only *one* free hydroxyl group. They exhibit only extremely feeble phenolic properties, are saturated, and depolymerize when distilled under atmospheric pressure. A study of the dimeric form of *iso*propenyl-*m*-cresol (I)[2] has shown that it yields on vigorous oxidation with potassium permanganate a stable carboxylic acid, $C_{12}H_{17}O.CO_2H$, by degradation of a *m*-cresyl group to a carboxyl group.



(I)



(II)



(III)

Only one very improbable structure has been proposed for these dimerides[3]; this contained an olefinic link, and was based on a formula for a condensation product of *m*-cresol and acetone now known to be incorrect[4]. There appears to be only one structure consistent with the above facts and with theoretical requirements. Solely on valency considerations, there are fourteen monohydric phenols (excluding those containing a 4-membered ring fused to an aromatic nucleus) which could be produced from two molecules of an *o*-hydroxy*iso*propenyl compound such as (I) by the mutual addition of the two *iso*propenyl groups and ring closure to a saturated cyclic ether. Of these structures, four may be rejected on stereochemical grounds as they contain 7- or 8-membered oxygen rings, and seven because they do not involve the unsymmetrical addition of the two *iso*propenyl groups, as occurs in the polymerization of styrenes and related compounds; the first step in the condensation is regarded as the formation of a $.CMe_2.\overset{(+)}{C}H{:}\overset{(+)}{C}Me.$ or less probably $.CMe_2.CH_2.\overset{(+)}{C}(:CH_2).$ bridge between the two aromatic nuclei[5]. Finally, two of the remaining three possibilities may be eliminated because in ring closure an oxygen atom must unite with the more cationoid of the two unsaturated carbon atoms (marked with (+)), the double bonds being polarized owing to the adjacent phenolic group. In the case of either intermediate the ring closure, therefore, leads to 2′-hydroxy-2 : 4 : 4 : 7 : 4′-pentamethylflavane (II), which must represent the dimeride of *iso*propenyl-*m*-cresol.

This structure adequately accounts for the cryptophenolic properties by the presence of the grouping $.C(O.)Me.CH_2.CMe_2.$ in the *ortho* position to the hydroxyl; the group $.CMe_2.CH_2.CMe_2$ even para to a phenolic hydroxyl group renders it extremely feebly phenolic. The acid, 2 : 4 : 4 : 7-tetramethylflavane 2-carboxylic acid (III), would not be expected to undergo further ready oxidation.

The structures of the dimeric forms of other *o*-hydroxy*iso*propenyl compounds must be analogous to (II), and there can be little doubt that the dimeric forms of cyclohexenyl-*m*- and *p*-cresols[6] are similarly constituted.

A full account of this work will later be published elsewhere.

Wilson Baker.
D. M. Besly.

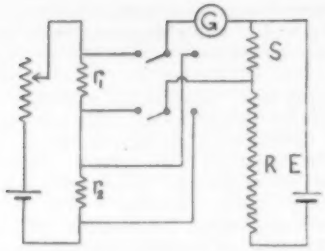
Dyson Perrins Laboratory,
University of Oxford.
Oct. 7.

[1] Fries, K., and Fickewirth, G., *Berichte*, **41**, 368 (1908); *idem*, *Annalen*, **362**, 42 (1908); Fries, K., Gross-Selbeck, W., and Wicke, O., *Annalen*, **402**, 306 (1913); Schering-Kahlbaum A.-G., Eng. Pat., 273,684 (1927); Jordan, H., Eng. Pat., 279,856 (1929). There is some doubt as to whether the substances described by G. Guillaumin, *Bull. Soc. Chim.*, [4], **7**, 378 (1910), and by J. B. Niederl, R. A. Smith and M. E. McGreal, *J. Amer. Chem. Soc.*, **53**, 3390 (1931), as the dimeric form of *iso*propenyl-*m*-cresol are really this compound.
[2] Eng. Pat., 273,684 (1927); Baker, W., and Besly, D. M., *J. Chem. Soc.*, 199 (1939).
[3] Jordan, H., Eng. Pat., 279,856 (1929). This structure has been accepted by F. Boettcher, Dissertation, Berlin (1930).
[4] Baker, W., and Besly, D. M., *J. Chem. Soc.*, 199 (1939).
[5] Compare structure of a dimeric form of anethole, Goodall, G. D., and Haworth, R. D., *J. Chem. Soc.*, 2482 (1930).
[6] Boettcher, F., Dissertation, Berlin (1930).

Comparing Resistances of Four-Terminal Resistors

In a letter in Nature of September 30, Mr. Arvon Glynne describes an elegant and simple method for the comparison of four-terminal resistors. In it, as he points out, two of the 'potential' leads have to carry a small current. I would like to direct attention to another method, almost as economical in apparatus, in which no current passes in any of these leads. Resistors of about 1/1000 ohm can be compared in this way with an accuracy of one part per thousand, using apparatus ordinarily available in a laboratory. The principle will be evident from the accompanying diagram.

A low-resistance storage cell E supplies current to the circuit R, S; and R is adjusted so as to obtain zero deflection of the galvanometer G, first with the resistor r_1 and then with r_2 in circuit. If good storage cells are used in both circuits, steady balances are



readily obtained. In practice, S is given such a fixed value (which need not be known precisely) that R will be several hundred ohms, or more, for either balance. Under these conditions, the resistance of the cell E will be quite negligible and

$$\frac{r_1}{r_2} = \frac{R_2 + S}{R_1 + S}.$$

This principle has, obviously, other applications; for example, to thermo-couple measurements, in view of the low values possible for the resistances of S and G.

John J. Dowling.

Department of Physics,
University College,
Dublin.

Decomposition of Hydrogen Peroxide by Catalase

In a recent letter[1] Johnson and van Schouwenburg dispute Keilin and Hartree's observation[2] that catalase activity depends on the presence of oxygen. In their reply, Keilin and Hartree[3] point out that the experiments of Johnson and van Schouwenburg are only qualitative and therefore not conclusive.

Soon after the publication of Keilin and Hartree's paper[2], we attempted to repeat their experiments, following all their directions as closely as possible, but with negative results. Our experiments were carried out in Warburg manometers with a purified catalase from red blood cells and with an enzyme from cucumber seeds prepared according to Zeile[4]. To ensure complete absence of oxygen, the manometers were gassed with purified nitrogen until no oxygen could be detected by the ferrous pyrophosphate method in control experiments. No difference was found in the rate of the decomposition of hydrogen peroxide in presence or absence of oxygen. The non-enzymatic decomposition was controlled in experiments with heat-inactivated enzyme and was certainly not larger than in the experiments of Keilin and Hartree.

The successive oxidation and reduction of catalase was first suggested by Haber and Willstätter[5] so long ago as 1931. This theory has been developed by one of us[6] along the lines previously suggested by Haber and Weiss[7]. It is based on a radical chain mechanism: the reduction of the ferric form of catalase is brought about by the anion of hydrogen peroxide (HO_2^-) and the oxidation of the ferrous form by the hydrogen peroxide molecule itself. The decomposition of hydrogen peroxide would therefore proceed with the same velocity in the presence and absence of oxygen, as we have indeed observed.

Although, contrary to Oppenheimer and Stern[8], it cannot be generally assumed that an oxidation by hydrogen peroxide would be faster than an oxidation by molecular oxygen, a re-oxidation of reduced catalase by oxygen only would have the effect that no decomposition of hydrogen peroxide could take place at all. The reason for this is that, unless a radical chain mechanism is assumed, all the oxygen formed by the reduction of the ferric form of catalase must be quantitatively used up again for the re-oxidation of a stoichiometric amount of the ferrous form and the oxygen thereby reduced to hydrogen peroxide. To avoid this difficulty, Keilin and Hartree formulated the oxidation reaction by the following equation:

$$4Fe^{\cdot\cdot} + 4H^{\cdot} + O_2 = 4Fe^{\cdot\cdot\cdot} + 2H_2O,$$

thereby assuming the reduction of oxygen to water without the intermediate formation of hydrogen peroxide. This is contrary to accepted theories of autoxidation and would appear impossible on the basis of the kinetic theory if only for the reason that it implies collisions of a very high order.

Further, on the basis of Keilin and Hartree's theory, one would expect the reaction, if carried out in nitrogen, to show the characteristic curve of an autocatalytic process owing to the increasing formation of oxygen. This is, however, not corroborated by the figures of Keilin and Hartree.

Conclusions as to the behaviour of catalase derived by analogy from spectroscopic observations on so-called 'azide- or hydroxylamine-catalase' cannot be accepted as strong evidence for the problem under discussion.

Joseph Weiss.

Department of Chemistry,
King's College.

H. Weil-Malherbe.

Cancer Research Laboratory,
Royal Victoria Infirmary,
Newcastle-upon-Tyne.

[1] Johnson, H., and van Schouwenburg, K. L., Nature, **144**, 634 (1939).
[2] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **124**, 397 (1938).
[3] Keilin, D., and Hartree, E. F., Nature **144**, 787 (1939).
[4] Zeile, K., and Hellström, H., *Z. physiol. Chem.*, **195**, 39 (1931).
[5] Haber, F., and Willstätter, R., *Ber. dtsch. chem. Ges.*, **64**, 2844 (1931).
[6] Weiss, J., *J. Phys. Chem.*, **41**, 1107 (1937).
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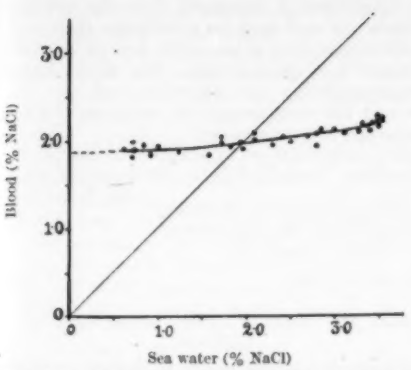
[8] Oppenheimer, C., and Stern, K. G., "Biological Oxidations" (The Hague: W. Junk, 1939).

Osmotic Behaviour of *Palæmonetes varians* (Leach)

Palæmonetes varians var. *microgenitor* is a common brackish-water inhabitant of northern and western Europe well known for its ability to live in different concentrations of sea water. Specimens collected from brackish waters in the vicinity of Plymouth (salinity 23–29 ‰) are quite at home in the tanks of the laboratory containing normal sea water of salinity 34–35 ‰. Estimations of osmotic pressure of blood, by Baldes' modification of Hill's thermo-electric technique[1,2], from specimens kept in different concentrations of sea water, indicate that while this species is hypertonic in sea water of lower dilutions, it is definitely hypotonic in normal sea water.

The blood of animals that have been in the sea-water tanks for some months is isotonic with a solution of 2·3–2·1 per cent sodium chloride. Hypotonicity is maintained by the shrimps in dilutions of sea water equivalent up to about 2·0 per cent sodium chloride, when the internal and external media are observed to be approximately isosmotic (see accompanying graph). In sea water of 1·8–0·6 per cent sodium chloride, there is a slight fall in the value



Relation between the osmotic pressure of blood and the external medium of *Palæmonetes varians*.

Values in per cent sodium chloride. Abscissæ, sea water; ordinates, blood. Straight line indicates where points would fall if blood and medium were isotonic.

for blood from 2·0 to about 1·8 per cent, but the blood always retains a higher osmotic pressure than the external medium, and variations are confined to the above limits. Dilute sea water equivalent to 0·6 per cent sodium chloride was approximately the lowest survival limit for the species in mixtures made with Plymouth tap water.

The homoiosmotic behaviour of the species is clearly indicated by the figures given above, the difference between the highest and lowest values for blood being only about 0·5 per cent sodium chloride for a corresponding difference of 2·9 per cent sodium chloride in the external medium. As compared with typical freshwater Crustacea[3,4,5] the blood of *Palæmonetes* is found to have a much higher osmotic pressure. It is all the more interesting because this property of maintaining hypotonicity in concentrated and hypertonicity in dilute sea water is known only in a few euryhaline crabs[6,7,8]. It would seem that this physiological character of *Palæmonetes varians* will to a great extent explain its peculiar habits and distribution.

Details of experiments will appear elsewhere.

N. Kesava Panikkar.

Marine Biological Laboratory,
Plymouth.
Oct. 11.

[1] Baldes, E. J., *J. Sci. Instr.*, **11**, 223 (1934).
[2] Hill, A. V., *Proc. Roy. Soc.*, A, **127**, 9 (1930).
[3] Duval, M., *Ann. Inst. Oceanogr.*, **2**, 232 (1925).
[4] Herrmann, F., *Z. vergl. Physiol.*, **14**, 479 (1931).
[5] Lienemann, L., *J. Cell. Comp. Physiol.*, **11**, 149 (1938).
[6] Edmonds, E., *Proc. Linn. Soc. N.S.W.*, **60**, 233 (1935).
[7] Conklin, R., and Krogh, A., *Z. vergl. Physiol.*, **28**, 239 (1938).
[8] Krogh, A., "Osmotic Regulation in Aquatic Animals" (C.U.P. 1939).

Amylase in Amphioxus

Specimens of *Amphioxus caribbaeum* collected while working at the Tortugas Laboratory of the Carnegie Institution of Washington were examined with respect to the amylase present in the gut. Determinations were carried out by the micro-method of Linderstrøm-Lang and Holter as modified by Holter and Doyle[1]. The intestine was divided into three regions, namely, hepatic cæcum, proximal intestine and lower intestine. The gut was split open, washed, and the area of each piece measured. When examined for amylase activity, the relative activities per unit area were found to be: cæcum, 62; proximal intestine, 41; lower intestine, 30.

In a determination of the relation of amylase activity to *p*H, the region of the junction of intestine, cæcum and pharynx was used. The final reaction mixture was 2 per cent glycerine, *M*/50 Sørensen phosphate buffer, 1 per cent soluble starch and 1 per thousand sodium chloride. The reaction time was 8–12 hours at 32·2° C. Taking the amylase activity at *p*H 7·0 equal to 100, the relation to *p*H is as shown in the accompanying table, with an optimum at *p*H 7·0. The values given are each averages of six determinations.

*p*H	Relative activity
6·5	75 ± 4
7·0	100
7·5	74 ± 3
8·0	69 ± 1

Wm. L. Doyle.

Bryn Mawr College,
Bryn Mawr,
Pennsylvania.

[1] Holter, H., and Doyle, W. L., *J. Cell. and Comp. Physiol.*, **12**, 295 (1938).

Cytochrome Oxidase in Tea Fermentation

An endo-enzyme system in tea leaf which could oxidize tea tannins directly was recently reported by Sreerangachar[1]. The enzyme remained bound to the tissue after exhaustive washing with water or phosphates of acetone-dried tea leaf tissue. Attempts to confirm this work in Assam at first proved fruitless. An enzyme preparation made apparently in identically the same way was completely devoid of oxidase activity. Tea tannin was not oxidized and no characteristic colour with the Nadi reagent was observed in the absence of hydrogen peroxide. An orange coloration developed in the fibrous portions of the leaf but this was found to be due to the interaction of the lignins with *p*-phenylene diamine. The endo-enzyme, however, showed strong peroxidase activity when hydrogen peroxide was added.

Some Ceylon leaf preserved under acetone which was sent to Tocklai still showed strong peroxidase activity, but no catechol oxidase activity could be detected.

On the other hand, it was shown at St. Coombs that the endo-enzyme could oxidize both tea tannins and catechol directly without the addition of hydrogen peroxide.

We believe the failure to confirm Sreerangachar's findings at Tocklai to be due to the higher temperatures prevailing in Assam. When green tea leaf is treated with alcohol at a laboratory temperature of 30° C. a crude enzyme preparation results with little or no oxidase but high peroxidase activity. If special precautions are taken to keep everything as cool as possible during the treatment of the tissue with alcohol, the enzyme preparation can bring about the oxidation of tea tannins and catechol without the addition of hydrogen peroxide. Treatment with alcohol at the higher temperature has obviously inactivated an enzyme which is essential for the direct oxidation of tea tannins.

The lability of this latter enzyme and the firmness of its attachment to the tissue suggests its identity with cytochrome oxidase. If this latter enzyme were present in the leaf, Sreerangachar's preparation would be expected to contain both the enzyme and its substrate. Cytochrome oxidase together with cytochrome can oxidize both catechol and ascorbic acid, although the enzyme alone is completely specific for cytochrome. The peroxidase in the preparation would also utilize the hydrogen peroxide produced during the oxidation of cytochrome for oxidation of its substrates. In these conditions, with hydrogen peroxide already present, addition of more hydrogen peroxide might not accelerate the oxidation, and the enzyme preparation would apparently have no peroxidase activity.

This interpretation would seem to explain our apparently contradictory findings as to the nature of the oxidizing enzymes in tea leaf. Sreerangachar's finding that tea tannin can be oxidized directly by an enzyme preparation obtained from tea leaf does not necessarily establish the presence of a tannin or catechol oxidase in the system. The claim put forward by one of us[2] that ascorbic acid oxidation is the primary stage in the fermentation process is also withdrawn. The direct oxidation of ascorbic acid by tea leaf tissue finds an adequate explanation in terms of the above theory. Other evidence has also been found against the existence of ascorbic acid oxidase in tea leaf, and these findings together with a fuller investigation of the cytochrome oxidase will be published elsewhere at a later date.

J. Lamb.
Tea Research Institute of Ceylon,
St. Coombs, Talawakelle,
Ceylon.

E. A. Houghton Roberts.
Indian Tea Association,
Tocklai, Cinnamara P.O.,
Assam.
October 5.

[1] Sreerangachar, H. B., *Curr. Sci.*, **8**, 13 (1939).
[2] Roberts, E. A. H., *Biochem. J.*, **33**, 842 (1939).

Role of Manganese in the Biological Synthesis of Ascorbic Acid

In continuation of my previous work[1], it has been found that the guinea pig liver also can synthesize ascorbic acid from the sugar precursors both *in vitro* and *in vivo*. The concentration of manganese necessary for the synthesis is much higher than that required in the case of rat liver.

In vitro			*In vivo*		
% Mn in R.-L.	Sugar	Mgm. ascorbic acid per gm. liver	Exp.	Mgm. ascorbic acid per gm. liver	Remarks
0·10	Mannose	0·20	1 c.c. N.S. intraperitoneally	0·21	Killed after five hours.
0·01	Mannose	0·14			
0·10	Galactose	0·17	40 mgm. galactose in 0·04% Mn intraperitoneally (1 c.c.)	0·25	
0·01	Galactose	0·13			
Nil	Nil	0·13			
			0·5 c.c. N.S. 25 mgm. mannose in 0·5 c.c. of 0·04% Mn	0·24	Young growing guinea pigs killed after 8 hours
				0·30	

The hypothesis is advanced that the inability of the guinea pig and man to synthesize their requirement of ascorbic acid is due to the lack or insufficiency of manganese in their tissues. The active oxidative or dehydrogenating mechanism is made up of manganese and the dehydrogenase, manganese acting in the capacity of a coenzyme.

Further investigation in support of the hypothesis is in progress. Details will be published elsewhere.

M. N. Rudra.
Department of Medical Chemistry,
Prince of Wales Medical College,
Patna. Sept. 25.

[1] Nature, **143**, 811 (1939).

Polyploids are More Variable than their Original Diploids

Studying the modification of a large number of experimentally produced polyploid plants of various species and families (Solanaceæ, Gramineæ, Compositæ, etc.) within the single plants and in the polyploid lines in respect to the modification of their diploid forms, when the plants grew in equal environmental conditions, I found the following regularities. Cell dimensions showed in the majority of the cases studied a greater modification in the tetraploid than in the diploid plants. Cell dimensions of the experimentally produced octoploids were more variable than the cell dimensions of tetraploid and diploid forms. The numbers of chloroplasts per pair of stomatal cells were more variable in the tetraploids than in the diploids and much more variable in the octoploids than in the tetraploids and diploids. Counting, for example, the chloroplasts[1] in 100 pairs of stomatal cells of each form of *Nicotiana alata*—diploid, tetraploid and octoploid, the following values for the standard deviations were respectively found: $\sigma_{2n} = 1{\cdot}81$, $\sigma_{4n} = 4{\cdot}76$, and $\sigma_{8n} = 7{\cdot}03$. (It was found that polyploidy does not affect the size of the chloroplasts[1,2]. It also does not significantly affect the variability of the chloroplast diameter.) The modification of the cell dimensions decreases somewhat gradually in the subsequent polyploid generations, that is, it decreases with the increase of the polyploid generations. But in the cases studied tetraploids still had more variable cell dimensions in the fifth generation than the corresponding diploids.

It was logical to expect that a greater modification of the cell sizes and of the numbers of the chloroplasts (assimilatory organs) of the polyploid forms should condition a greater modification of the plant size as well as of all the dimensions of the plant organs. Our measurements showed that this is true in the majority of the cases. Plant size, leaf dimensions, and flower dimensions were in the majority of the cases much more variable in the tetraploids than in the diploids. The organ dimensions of the octoploids were more variable than those of the diploids and tetraploids.

It was also logical to expect that a greater modification of the cell dimensions of the octoploid and tetraploid plants should lead to more frequent developmental anomalies. It was found that tetraploid plants formed a greater percentage of abnormal flowers and leaves than the diploids. The tendency was noted for tetraploids originating from species with large chromosome numbers to form a somewhat greater percentage of abnormal flowers than the tetraploids originating from species with small chromosome numbers. Experimentally produced octoploids formed a much greater percentage of

abnormal flowers and leaves than the tetraploids and diploids. Modifications of the organ dimensions and larger percentages of anomalies of the tetraploids have the tendency somewhat to decrease with the increase of the polyploid generations, but in the majority of the cases both were still greater in the tetraploids than in the diploids.

F_1 species hybrids of distantly related species had, in the majority of the cases, more variable cell and organ dimensions than the parental species; they also formed abnormal leaves and flowers more often. Cell dimensions of the majority of the amphidiploids that were studied were also more variable than those of F_1 species hybrids from which they were produced. They also formed abnormal organs more frequently. An amphidiploid, however, did not show greater modifications of the cell and organ dimensions and did not form many more abnormal flowers and leaves than the F_1 hybrid from which it originated, but the latter was a cross product of distantly related species, showing very great modifications of cell and organ dimensions and forming a very large percentage of abnormal flowers and leaves. The numbers of seeds set per flower by the auto- and allo-polyploid plants were much more variable than the numbers of the seeds set by their ancestral forms. A series of allopolyploid species, studied recently, showed greater modifications of cell and organ dimensions than the diploid species of the same genus. But there were also allopolyploid species that did not show greater modifications of the cell and organ dimensions in comparison with the diploid species of the same genus. The increase of the modifiabilities of polyploids and of certain F_1 species hybrids (the products of distantly related species) are of great significance from the evolutionary and plant breeding (agricultural) points of view, because they are closely connected with the plasticity and adaptability of the plants, playing at the same time an important role in the geographical distributions of the plant organisms.

A series of allopolyploids and F_1 hybrids have, in addition to the increased modification, increased frequency of abnormal mitosis[3], and more often produced somatic mutations[3,4] than the parental species. Both allopolyploids and autopolyploids that propagate sexually often give rise to new hereditary variations as a result of abnormal meiosis and crossings-over between partially homologous chromosomes[5,6]. Extensive studies in the genuses Triticum and Nicotiana showed that in the majority of the cases polyploids are characterized by a much greater polymorphism than diploids. Our data are in close agreement with those obtained by N. I. Vavilov upon the same problem but from another point of view.

Dontcho Kostoff.

Institute of Genetics,
Academy of Sciences of the U.S.S.R.,
Moscow. August 22.

[1] Cf. Kostoff, D., *Curr. Sci.*, **7**, 270–273 (1938).
[2] Kostoff, D., and Orlov, A., *Ann. Bot.*, **2**, 883–886 (1938).
[3] Kostoff, D., NATURE, **144**, 599 (1939).
[4] Kostoff, D., *Curr. Sci.*, **3**, 302–304 (1935).
[5] Kostoff, D., and Kendall, J., *Gartenbauwiss.*, **9**, 20–44 (1934).
[6] Kostoff, D., *J. Genet.*, **37**, 129–209 (1938).

Sir Frank Dyson

I HAVE been planning to write the life of my father, the late Sir Frank Dyson (formerly Astronomer Royal), but owing to war work have had to postpone the task for the present. I am, however, anxious to collect letters and other material before these are destroyed.

May I appeal to those who knew my father for any letters they may have of his, or for any reminiscences they may care to give me. I should very much value the personal reminiscences of his scientific friends.

I shall naturally take the greatest care of all papers sent to me, and I undertake to return them within a few days.

Margaret Wilson.

The Chimes,
Radford Rise, Stafford.

Points from Foregoing Letters

OBSERVATIONS are recorded by A. C. B. Lovell and J. G. Wilson of the frequency with which cosmic ray showers from the atmosphere affected two cloud chambers operated simultaneously and arranged in different ways. From the average multiplication observed when lead or aluminium is interposed between the chambers, they conclude that large showers will be relatively more frequent in light elements than is indicated by the cascade theory applied to a single entrant particle.

The evaporation of droplets in mists of phenolic germicide solutions has been studied by S. R. Finn and E. O. Powell by means of the ultra-microscope. The results, correlated with the biological findings, show that three rough classes of bactericidal behaviour are distinguishable according to the volatility of the solute.

From a study of the dimeric forms of *o*-hydroxy-*iso*propenyl compounds, W. Baker and D. M. Besly conclude that they must be derivatives of flavane. This structure satisfactorily explains their properties.

J. J. Dowling describes a method for the comparison of small resistances using ordinary laboratory apparatus.

J. Weiss and H. Weil-Malherbe state that further quantitative work on the action of catalase has shown that catalase activity does not depend on the presence of oxygen. This is in agreement with the theory proposed recently and based on the earlier discussion by Haber and Willstätter. It was not possible to corroborate Keilin and Hartree's results, whose theoretical views are also criticized.

N. K. Panikkar finds that *Palæmonetes varians* is hypotonic in normal and hypertonic in dilute sea water. The osmotic pressure of its blood ranges from 1·8 to 2·3 per cent NaCl for a corresponding range of 0·6–3·5 per cent NaCl in external medium, isotonicity being at about 2·0 per cent. The homoiosmotic behaviour of the species is of interest in view of its habits and distribution.

In examining the intestine of Amphioxus for amylase activity, W. L. Doyle found that the greatest activity per unit area was in the cæcum and the least in the lower intestine. The relation of *p*H to amylase activity was also studied and showed an optimum at *p*H 7.

J. Lamb and E. H. Houghton produce evidence that the oxidase responsible for the oxidation of ascorbic acid in the tea leaf may be identified with cytochrome oxidase, and that it is unlikely that an ascorbic acid oxidase is present.

RESEARCH ITEMS

Ghost Figures of Santa Cruz

The wooden figures from Santa Cruz, which represent the ghost or soul of a person who has been successful during his life and has gained prestige, are figured and described by Joyce Gillett, of the Cranmore Ethnographical Museum, Chislehurst, in *Man* of October 1939. These wooden figures are made after death and erected in the house of the deceased, when a feast is given. After the feast, the figure remains in the house standing in a corner. Very often skulls are seen standing around the figure, and these are said to be the skulls of past owners and keepers. Each figure has one keeper, and often gifts of tau and conch shells are placed before it. The figures are made, and regarded with esteem, not on account of an unwillingness to forget the dead, but because of a fear that unless something tangible is made in the likeness of a man who was lucky, that which was for the good of the people during his lifetime may be lost for ever. But if such an image is made, it is believed that the maker has captured for all time the gift of being lucky which was bestowed on the deceased, and this can now be transferred into the body of any living person—usually a member of the family or a relative—where it will continue to function. One example, now in the Cranmore Museum, was found in a disused house, not a ghost house, suspended from a height of five feet, and encased in a conical bird-cage of wood, the whole being covered with mats and tapa cloth, which appeared to have been smoked over a fire. On unwrapping, a very carefully decorated male form was found, in the nose and ears of which were pendants of pearl shell; pearl shell pendants hung on the hair, which was wrapped in tapa cloth and dressed in the shape of a cone, and protruded at the back of the neck. Biceps, wrists, knees, and ankles are circled with fibres on which are pendants and adornments of shell or seeds, while around the waist was a loin-cloth and a girdle of currency. The whole figure was dusted with turmeric.

The Quintuplets

J. W. MacArthur and A. R. Dafoe (*J. Hered.*, **30**, 359–364; 1939), continuing their analysis of the Dionne quintuplets examine their growth up to their fifth birthday. The quintuplets were unlike at birth but have become, as is usual in monozygotic twins, more similar than fraternals. The variability in weights was greatest at times when growth was retarded—birth—weaning—before removal of tonsils. The maximal differences fell from 45·1 per cent at birth to 7·2 per cent at five years. Similarly height differences fell from 4·5 per cent at one year to 1·1 per cent at five years. The rates of growth of the quintuplets are neither equal, nor proportional to birth weight, but are regulative as with regenerating parts which tend to reach their potential dimensions under equal environmental conditions.

Inheritance of Disease-Resistance

L. T. Webster (*J. Hered.*, **30**, 365–370; 1939) has analysed the reactions of mouse populations to mouse typhoid and encephalitis virus. Progenies of parents who died within 10 days of infection with mouse typhoid were more susceptible than those from surviving parents. Selection and inbreeding from susceptible and resistant parents retained these characteristics, while hybrids between highly resistant and highly susceptible mice showed a monofactorial F_2 segregation for resistance to both typhoid and encephalitis virus. Resistance is dominant in both cases. The outbreak of epidemics in genetically heterogeneous populations is discussed. Epidemics are caused in hitherto uninfected populations by the introduction and spread of a highly virulent, yet stable infecting, agent. In an infected population the agent remains stable but the resistance of the population is reduced by inadequate diet or other causes. The dosage in the population therefore increases. Those individuals which are innately susceptible become infected first. The epidemic curve reflects this genetical difference in susceptibility.

Genetic Differences in Wild *Drosophila pseudoobscura*

Th. Dobzhansky (*Proc. Nat. Acad. Sci.*, **25**, 311–314; 1939), continuing his studies on genetical differences in wild populations, shows that samples of different populations of *Drosophila pseudoobscura* caught in southern Texas show structural differences in the third chromosome similar to those previously found in California. Further, although some populations were only 1½ miles apart, these appeared to be different in constitution and to be distinct breeding units.

Mouth-parts of the Female Anopheles Mosquito

In *Parasitology* (**31**, 212–242; 1939), G. G. Robinson gives an account of the piecing mechanism used by the female mosquito during feeding. It appears that the observation made by Vogel in 1920 that the labral canal is closed ventrally by the opposed edges of the labral groove is confirmed. The hypopharynx, on the other hand, plays no part in the ventral closure of the food channel, except at its base. The use of the term 'labrum-epipharynx' is dispensed with in favour of the simple designation of 'labrum'. Snodgrass, it is pointed out, disagrees with the homology of the labella with labial palpi on the ground that the lobes of the labium have usually each a single muscle inserted directly upon it, whereas the palpi have antagonistic muscles. It is shown that in Anopheles the labella have these antagonistic muscles as in typical palpi, and the homology is consequently upheld. During feeding, penetration of the skin of the victim is made by the labrum and the wide terminal blades of the mandibles act as a cap to the entrance of the labral canal and serve for its protection during penetration. The function of the maxillæ is to help in the efficient and smooth penetration of the host's skin.

North American Bees of the Genus Osmia

Under this title the Entomological Society of Washington presents the first volume of what is expected to be a series of memoirs. Written by Grace A. Sandhouse, it is a cloth-bound publication of 167 pages and was issued in August 1939. Bees of

the genus Osmia are essentially denizens of the palæarctic and nearctic regions, few being found elsewhere, and they are entirely wanting from the nearctic and Ethiopian regions. Of approximately 280 names, which have been proposed for species of Osmia in the nearctic region, about 120 become synonyms and 30 are referred to other genera, thus leaving 130 names now in the genus. The issuing of this memoir was made possible from accumulated interest on a monetary bequest of the late Frederick Knab which was supplemented by a donation by Dr. E. A. Schwarz. Inquiries regarding the sale of this publication should be addressed to the Corresponding Secretary of the Entomological Society of Washington, care of the Bureau of Entomology and Plant Quarantine, Washington, D.C.

Disastrous Earthquakes, January–June 1938

J. P. Rothé has discussed the earthquakes felt by man during the first six months of 1938 (*Revue pour l'étude des calamités*, 2, No. 7, 230–241; July–August 1939). The five most disastrous shocks were those of February 5 in Columbia, April 19 in Asia Minor, May 3 at Iguala in Mexico, May 19 at Célèbes, and June 11 in Belgium. The epicentral region of the Columbian earthquake, which was felt as far as Panama, corresponded roughly with the great 'graben' of the Cauca Valley, the depth of focus being 150 km. Considerable damage was done and people were killed and injured at Armenia, Calarca, Pereira, Manizalles, Aranzazu, Villa Maria, Riosucio, Aguadas, Medellin and Amaga. Probably the greatest shock of the period was the one with epicentre in the vilayet of Kirsehir in Turkey, where ten villages were completely destroyed. Altogether about 756 houses were destroyed and 800–1,000 people were killed or gravely injured. The epicentre of the earthquake of May 3 has been determined at the Observatory of Tacubaya to have been near Huilziltepec (Guerrero). This shock resulted in the destruction of much property, the deaths of five people and injury to thirty-eight others. The earthquake of May 19 with epicentre in the Straits of Macassar was particularly violent and did great damage at Dongala, where sixty houses were ruined. The earthquake was followed by a sea wave 2–3 m. high which flooded areas 80–100 m. inland, doing great damage to dwellings, crops and merchandise and resulting in death and injury to several people. According to M. O. Somville, the epicentre of the Belgian earthquake of June 11 was in the centre of the Mons-Brussels-Ghent triangle and its depth of focus 50 km. This shock resulted in the deaths of three people and damage to property of several millions of francs. Damage to property was at Brussels, Audenarde, Courtrai, Lille, etc., windows were broken at Anvers, and the shock was felt at Paris and at distances up to 300 kilometres from the epicentre.

Velocity of Coloured Light

During the last twenty years, observations have been made to determine whether light of different colours travelled through interstellar space with the same velocity. They have in general been based on observations of the times of the primary minima of the light of two wave-lengths of a binary star, generally Algol. Some have led to the conclusion that red light travels faster than blue, others the reverse. The question has been recently examined by J. S. Hall of Amherst College Observatory, working at the Sprout Observatory with grants from the American Philosophical Society and Swathmore College (*J. Franklin Inst.*, 228; Oct. 1939). He measured the light of Algol, of wave-lengths 5599 A. and 8060 A. respectively, by a photo-electric photometer and compared them with that of a non-variable star Alpha Persei, making corrections for background illumination, atmospheric extinction and sensitivity of the photometer. He concludes that the minima for the visual and infra-red rays occur at the same time with an uncertainty of 3 minutes. As the light from Algol takes 195 light years, that is, 55×10^6 minutes, to reach the earth, this means that the speeds of the two lights are identical to within 3 parts in 55 millions. This supports the similar conclusion of Russell, Fowler and Borton from the scarcity of matter in interstellar space and the earth's atmosphere.

The Minor Planets of the Hecuba Group

The above is the title of the Halley Lecture delivered by Prof. A. O. Leuschner on June 16, 1938 (Oxford: Clarendon Press. 3*s*. 6*d*. net). The Hecuba Group comprises about one third of all the known minor planets, and they revolve about the sun with approximately twice the angular daily rate of Jupiter. When very close commensurability exists, for example, if a planet revolves at almost twice the angular daily rate of Jupiter, the determination of the exact motion of the planet becomes complicated. Bohlin's Group Method has been applied to the problem with considerable success, and von Zeipel and also Leuschner and his colleagues have developed the method, tables being published to facilitate the computations. In the "Berkeley Tables", produced by Leuschner, higher order terms have been used than were employed by von Zeipel, and their application to Hygeia and a few other planets confirms their great accuracy. The Rechnen-Institut has recently utilized these tables for the development of the perturbations of the planets of the Hecuba Group, and Dr. Raube has already published the results for Erato and Antiope. There is a considerable amount of detailed examination of particular cases which present various difficulties, and those who are engaged in this highly specialized form of work will find much useful material in Prof. Leuschner's lecture to assist them.

New Mathematical Tables

A seven-place parallel table of $\tan^{-1} x$ in radians and $\log_{10}(1 + x^2)$, computed by Dr. L. J. Comrie, has been added to the "Tracts for Computers" of the Department of Statistics, University College, London. Prepared in the first instance to assist in the fitting of curves of Pearson's Type IV to frequency distributions, the table will obviously assist in any other problem which involves the numerical integration of a rational function with a definite quadratic denominator; that the logarithms are not natural does not imply a complication in practice, for in any application except to a manufactured example a logarithm is sure to be multiplied already by some numerical constant. Second differences are provided for interpolation, and Dr. Comrie's name is a guarantee of absolute accuracy. The printing is excellent, and if we complain that paper wrappers are an inadequate protection, that is because we have no doubt that the tables are going to be subjected to hard wear. The tables are published by the Cambridge University Press, price 3*s*. 9*d*.

COALBURSTING

As the coal mines of Great Britain were mechanized, the standard practice became to undercut the coal seam by means of a coalcutting machine and then to bring down the coal by drilling holes in the seam above the cut, inserting charges of 'permitted explosives' and then detonating these. This method of winning coal, however, suffers from grave disadvantages. Every shot that is fired is a potential danger, especially when detonation results in what is technically known as a blown-out shot. Even if no explosion results, the cloud of coal dust produced tends to make the mine atmosphere unpleasant and dangerous. Furthermore, when shots are being fired, the workmen must be withdrawn from the coal face to a place of safety, thus interrupting work. Finally, the shock of the explosion may damage the roof so that the men on returning to the face are confronted with a changed set of conditions which may be very dangerous, especially when the roof is friable. When it is realized that in a single colliery 100,000 shots may be fired per annum, the magnitude of the potential danger is obvious.

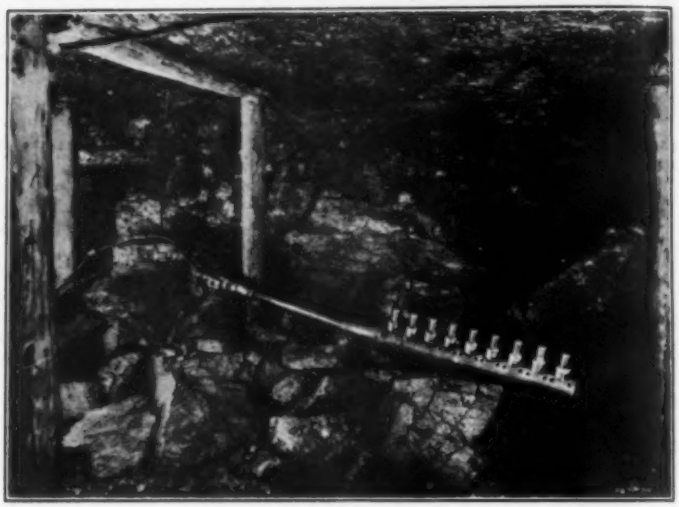


Fig. 2.

Dislodgment of coal completed: note the pistons of the coal-burster fully extended and the chunky nature of the coal brought down.

Any method which obviates the necessity for firing shots is of interest to the mining community, and furnishes an opportunity for pure science to be of assistance to industry. A great variety of chemical and physical methods of bringing down coal have been tried during the last fifty years, one of these being the Tonge hydraulic wedge. The modern 'coal-burster' is a development of Tonge's hydraulic wedge which has been made possible by the developments in metallurgical science and engineering practice in relation to the transmission of hydraulic power at high pressure. It entirely eliminates shot-firing and has been used over a sufficiently long period of time for its usefulness and efficiency to be assessed; several hundred coal-bursters are now in use in the British coalfields.

Fig. 1.

Building up pressure in the coal-burster.

In coalbursting, the seam is undercut as before with a mechanical cutter and holes are bored in the coal above the cut by electric drills or compressed air drills of the turbine type. Now, however, the coalburster is placed in the hole instead of a charge of explosive. Briefly, the coalburster consists of a round stainless steel barrel (about 3 ft. in length and 3 in. in diameter being a common size) chambered on one or both sides to accommodate a number of pistons, or plungers, each about 2 in. long, which can be forced out radially from the barrel by hydraulic pressure. This hydraulic pressure is developed by a small hand-pump, connected to the burster by a length of armoured hose, a pressure of some

15,000 lb. to the square inch being developed and communicated to the pistons. Since the hole in the coal has been drilled as a snug fit for the bar and steel liner which goes beneath it, the forcing out of the pistons involves the disrupting and breaking down of the coal. After the burster has been placed in the hole, the miner retires to the pump some 10–20 ft. away and operates the hand pump to generate the pressure required to burst down the coal. As a rule, the coal comes down within two or three minutes of commencing to operate the pump, and several tons of coal are brought down at each operation.

One advantage of this technique is obvious—there is no possible risk of an explosion. Moreover, very little coal dust is produced, so that conditions predisposing towards an explosion are absent, and, of course, the mine atmosphere is much pleasanter and healthier for the workmen. Again, round coal of maximum market value is produced and it is not shattered or rendered 'tender' by an explosion; therefore it does not suffer from disintegration in transport. Finally, but not least important, the roof is in general not disturbed. Should any change in conditions take place, however, the fact that the men are present all the time, and not withdrawn as in shot-firing, means that there is a very much better chance of detecting changes in roof conditions.

It is found in practice that the coalburster has very few limitations, that it will operate successfully on all types of coal, hard or soft, in stalls as in wide-work, and will function well under a variety of conditions. One colliery in Great Britain has for some years now been getting its whole output (8,000 tons per week) by means of coalbursters, shot-firing being completely eliminated. The device must be looked upon as a notable contribution to the safer working of coal mines and to the production of coal of higher market value than has been possible by the use of explosives.

A. Harvey.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN NEW ZEALAND*

THE thirteenth annual report of the Department of Scientific and Industrial Research, New Zealand, which covers the year 1938–39, refers to the initiation of a number of new research activities. One of the most important of these is the formation of a Timber Protection Research Committee of the Council to direct and co-ordinate research on the preservation of timber from the attacks of wood-boring insects and fungi. The depreciation of building securities from the attacks of these pests presents a serious problem in New Zealand, and the research programme planned by the committee contemplates work by the Entomological Division and Plant Diseases Division of the Plant Research Bureau, including biological studies of wood-infesting insects, penetration tests for wood preservatives, and toxicity tests with insects and fungi, as well as further work in the Dominion Laboratory on the analysis of wood preservatives and the chemical aspects of penetration tests.

The serious effects of uncontrolled soil erosion have led to the establishment of an expert technical committee on soil erosion and land deterioration, to report on the measures necessary to maintain vegetative cover in New Zealand and prevent irreparable damage. The report of this committee is in process of publication and indicates that in few cases is the damage beyond repair, although in many areas soil erosion has reached a serious state, and a programme to handle the problems that are now apparent is outlined.

In addition to its intensive studies on cheese starters, the Dairy Research Institute has carried out a number of investigations on butter-making, including the oxidation of the fat of butter in cold storage, starters for butter, and the factors affecting hardness of butter. Other work has been concerned with the chemistry of incipient oxidation defects in butter, and the control of mould in dairy products, including the resistance to mould attack offered by different pigments, and the effect of various paint vehicles and driers. The Plant Diseases Division of the Plant Research Bureau has continued its investigations on the control of dry rot in swedes and turnips, the control of club-root, and the use of arsenate, derris and nicotine sprays and dusts for the control of diamond-back moth. Other work of this Division has been concerned with timber preservation and the testing of seed disinfectants; a fourth list of certified sprays has been issued. The Entomological Division has continued its work on the introduction of parasites for the control of the diamond-back moth, on the sheep maggot fly problem, and on timber borers. Animal research at Massey College has been concerned with the application of accurate scientific methods for measuring wool characteristics to the grading of individual stud sheep, and arrangements are being made with the Wool Manufacturers Research Association at Dunedin for the commercial processing of wool with known and accurately measured characteristics.

Fruit research has covered fertilizer, rootstock and pruning experiments on apples, and studies for the chemical control of bronze-beetle and red-mite, physiological studies of internal cork of apples, spraying experiments and the testing of certified sprays. The Fruit Cold Storage Committee has investigated the use of copper-treated wraps for the control of the spread of grey mould in winter cole pears, as well as the effect of fertilizer treatment on the keeping quality of Cox's Orange Pippins and other varieties of apples. Storage trials have been continued with Ballerat and Washington apples. Experimental work on boron in relation to physiological diseases has been directed towards the persistence of boron dressings in soil.

The Tobacco Research Advisory Committee has been concerned with seed-bed experiments, seed germination studies and investigations on mosaic disease. The plant selection work has yielded a natural Italian perennial rye grass cross ecotype,

* Thirteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 134. (Wellington, N.Z.: Government Printer, 1939.) 2s. 9d.

showing definite promise for short-rotation arable lye, such as occurs in the South Island. Interesting work has been carried out by the Plant Chemistry Laboratory on plant growth-substances and their effect in promoting the rooting of cuttings, and particularly effective results have been obtained with β-indolylbutyric acid.

The report also refers to the work of the Leather and Shoe Research Association, the Wool Manufacturers Research Association, which has continued the study of the raw wool scouring process, to radio research, the activities of the Social Science Research Bureau and of the Dominion Laboratory and Geological Survey.

THE CRAB NEBULA: A PROBABLE SUPER-NOVA

THE Crab Nebula in Taurus, which has the distinction of being No. 1 in Messier's Catalogue, is of peculiar interest, as is shown by articles published respectively in *L'Astronomie* (August 1939) and in the *Telescope* (September 1939). These articles summarize the results of several technical papers published on this subject during the past few years. It seems likely that the Crab Nebula was first recorded by John Bevis, an English physician, in 1731. It was rediscovered in 1758 by the French astronomer, Charles Messier, and was later the subject of careful scrutiny by Sir William Herschel. It was observed with the great reflector at Parsonstown, Ireland, by Lord Rosse, whose drawing of the nebula, published in 1844, probably suggested its name. It remained, however, for astronomical photography to show, first in 1892 by Isaac Roberts and later by the American astronomers (Keeler, Curtis and Ritchey), its peculiar filamentary structure and afterwards to provide data for measuring its linear rate of expansion of about 0·18″ per annum.

Using this value and the present angular dimensions of the nebula and extrapolating backwards, an interval of about 800 years is obtained for the nebula to expand from a point of origin. A similar time interval (900 years) was obtained by Hubble. Spectra of the Crab Nebula, first obtained in 1913–15 at the Lowell Observatory, showed a bowing of the emission lines, when the slit of the spectrograph crossed the whole extent of the nebula (major axis 6′). Interpreting this feature as a differential Doppler effect due to the approaching nearer side of a shell of gas and the receding further side, Mayall in 1937 derived a velocity of expansion of about 1,300 km./sec. from Lick spectrograms. Assuming a constant rate of expansion, he concluded from the available data that the epoch of the outburst was about A.D. 1100. Meanwhile, Lundmark had pointed out that the Crab Nebula was near the position of the bright object recorded in Chinese and Japanese annals as having been seen for six months in A.D. 1054. In 1934, a translation by Y. Iba of the Japanese records gave the position of the object as near the star ζ Tauri and its brightness as equalling that of Jupiter. By combining the apparent linear expansion in seconds of arc per annum with the absolute expansion in km./sec., the order of distance was derived as 1,500 parsecs, equivalent to nearly 5,000 light years. Using this distance and the apparent magnitude of Jupiter (− 2·2 m.), the absolute magnitude of − 13·1 is obtained for the nova, which must have been at least one hundred times as bright as an ordinary nova.

In *Contributions* from the Mount Wilson Observatory No. 600, W. Baade assembles the evidence for the existence of two classes of novæ, common novæ and super-novæ, which differ in luminosity by a factor of about 10,000. Typical of the former class is the nova which appeared in the Andromeda nebula in 1885 and reached a maximum apparent visual magnitude of 7·2, equivalent to an absolute magnitude of − 15·0. To this recently recognized class of super-novæ, so the evidence suggests, the nova of 1054 may have belonged, and the expanding shell of gas originating with the cosmic explosion is still visible as the Crab Nebula.

TREATMENT FOR ROT-PROOFING SANDBAG REVETMENTS

SANDBAG revetments exposed to the weather tend to break up, due to rotting of the sandbags, and inquiries have been made about preservatives. Two types of preservative are suitable. They are respectively a creosote or tar distillate, used as a water emulsion, or a solution of an organic copper salt in creosote made up into an emulsion. The former is more widely available than the latter and is suitable for treatment of revetments in position which have already deteriorated by being exposed to the weather for some time. The latter is more potent but is also more expensive, and its use will not generally be justified unless the bags are in good condition and unless it is desirable to take down the whole revetment, treat all the bags and then re-pile them.

The application of the preservatives should conform with the following specification:

(1) A creosote or tar distillate of medium creosote type applied as a water emulsion in such a quantity as to give on the exposed portion of the bag a coating of creosote not less than one fifth of the normal dry weight of the fabric exposed. This is given approximately by a 25 per cent creosote emulsion when sprayed on the bags to give a thorough coating completely satisfying the absorption of the fibres. The creosote should comply with British Standard Specification No. 144/1936, 'Creosote for preservation of timber'.

Any normal emulsifying agent may be used and the following is given as an example of the process of emulsification.

The following ingredients are used: 65 parts creosote and 35 parts water with 1·2 parts oleic acid, 0·8 parts casein and 0·36 parts sodium hydroxide as the emulsifying agent. The agent is dissolved in water and the two fluids are mixed in a jet similar to that of a cream-making machine. An emulsion prepared in this way should be stable and can be transported in drums or kegs. Before use it should be diluted with water to a suitable consistency for spraying so that the creosote content does not fall below 25 per cent.

(2) An organic copper salt is dissolved in creosote or tar distillate of the type indicated in (1) above, the solution then being made up into an emulsion with water, by the use of a special type of emulsifying agent. The copper salt should be one of an organic fatty acid of high molecular weight (such as, for example, copper oleate). The organic copper salt should be added in the proportion of 16 per cent of the weight of the creosote, and the whole should be emulsified with water. When sprayed on the bags it should be applied as 20 per cent emulsion. This will leave 0·5–1·0 per cent of metallic copper, estimated on the normal weight of the fabric when conditioned under ordinary atmospheric conditions.

Care should be taken to coat thoroughly any seams visible on the face of the pile and to work the emulsion well into the seams. The spraying should be done with a paint spray or horticultural spray, and the stirrup-pump recommended for A.R.P. fire protection may be used if no other spray is available. Care is needed to avoid fire risk during application as when handling creosote in the ordinary way. As creosote may cause permanent stains, suitable measures should be taken to protect the surface of buildings against which the bags are placed whilst spraying is in progress.

In order to obtain the best possible penetration into the revetment the preservatives should not be applied immediately after a heavy rain. They will be far more effective if the pile is given a reasonable time for drying after rain.

It will be desirable to repeat the treatment, and this should be done at intervals not exceeding three months.

UNIVERSITY EVENTS

Durham.—The honorary degree of D.C.L. has been conferred on Sir Charles Peers, chief inspector of ancient monuments and architect in charge of the Durham Castle restoration scheme since 1933. The honorary degree of M.Sc. has been conferred on Mr. C. A. Linge, clerk of works for the scheme.

London.—Owing to the war, and the absence of the University from London, the following honorary degrees among others have been conferred *in absentia*: D.Sc. on Prof. Niels Bohr and Sir Robert Robinson; D.Sc. (Economics) on Mr. R. G. Hawtrey and Mr. Simon Marks.

Oxford.—R. S. G. Rutherford, Wadham College, has been appointed a research officer in the Institute for Research in Agricultural Economics as from October 1.

Dr. S. N. Chakravarti, St. Catherine's Society, has been granted the degree of D.Sc. for his work in synthetic organic chemistry.

SCIENCE NEWS A CENTURY AGO

Fecundation and Development of Plants

At a meeting of the Ashmolean Society, at Oxford, on November 19, 1839, Prof. Daubeny explained the new views with respect to the fecundation and the development of plants, which had been brought forward by Brown, Mirbel, Schlieden and other botanists of the day. When Linnæus, he said, had established the doctrine of the sexuality of plants he left to his successors two branches of inquiry in a manner untouched, namely, first, in what precise method do the stamens operate upon the pistils when they cause fecundation to take place; and secondly, to what extent can we trace an analogy between the mode of fecundation and development in the case of flowering plants where sexes exist, and in that of cryptogamous ones, where they are not discoverable. The first of these points had been elucidated by the researches of Brown, A. Brongniart and Ehrenberg, while the analogy subsisting between flowering and cryptogamous plants had been investigated by Mirbel in France and Schlieden in Germany. The former observed new cells originating out of those already existing in the case of Marchantia; while the latter appears to have shown that a process the same in kind takes place within the pollen tubes emitted from flowering plants at the very time they reach the ovary and impregnate it, as well as the cells of the plant in the subsequent stages of its growth. From Schlieden's researches it would seem to follow that the embryo exists in the pollen, and not in the ovary; the office of the latter organ being merely that of furnishing to the young individual a receptacle and nourishment. This, however, was disputed by Mirbel.

Conception of the Steam Hammer

In his "Autobiography", James Nasmyth, when speaking of the iron ship *Great Britain*, which it was at first intended to drive by paddlewheels, said that Mr. Francis Humphries, finding great difficulty in obtaining tenders for the large wrought iron shaft, approached Nasmyth. "In this dilemma," said Nasmyth, "he wrote a letter to me. . . . This letter immediately set me a-thinking. How was it that the existing hammers were incapable of forging a wrought-iron shaft of thirty inches diameter? Simply because of their want of compass, of range and fall, as well as of their want of power of blow. A few moments' rapid thought satisfied me that it was by our rigidly adhering to the old traditional form of a smith's hand hammer—of which the forge and tilt hammer, although driven by water or steam power, were mere enlarged modifications. . . . The obvious remedy was to contrive some method by which a ponderous block of iron should be lifted to a sufficient height above the object on which it was desired to strike a blow and then to let the block fall down upon the forging, guiding it in its descent by such simple means as should give the required precision in the percussion action of the falling mass. . . . I then rapidly sketched out my Steam Hammer, having it all clearly before me in my mind's eye. In little more than half an hour after receiving Mr. Humphries's letter narrating his unlooked-for difficulty, I had the whole contrivance, in all its executant details, before me in a page of my Scheme Book. . . . The date of this first drawing was the 24th November, 1839."

The Fossil Fishes of the Yorkshire Coalfields

On November 20, 1839, the naturalist William Crawford Williamson (1816–95) contributed to the Geological Society a paper "On the Fossil Fishes of the Yorkshire and Lancashire Coal Fields". Within the previous four years the Coal Measures of these counties had assumed a zoological importance which hitherto they had not been supposed to possess. In Lancashire ichthyolites had been lately found to pervade the whole of the series from the Ardwick limestone to the millstone grit, and in Yorkshire they had also been found in abundance. These remains, except in the case of the Ardwick limestone, always occurred in highly bituminous shale and were most abundant where plants were least numerous. The fishes were found chiefly in the roof of the coal, rarely in the seam itself, and not often in its floor. The author made some observations on the manner in which ichthyolites were associated with other fossils in the Coal Measures. At Burdiehouse they occurred in the midst of fresh-water shells and Cypris; at Coalbrook Dale with marine Testacea; at Middleton, near Leeds, with Lingulæ; and at the top of the series in Lancashire and Derbyshire with Mytili and Melaniæ. When he read this paper, Williamson was a medical student; in 1851 he became first professor of natural history, anatomy and physiology at Owens College, Manchester. He was Wollaston medallist in 1890.

Roman Causeway

"Some works for improving the channel of the Scheldt", according to the *Gentleman's Magazine* of November, 1839, "have occasioned several extensive cuttings across the old Roman causeway called La Chaussé de Brabant de Brunehaut, which connects in a straight line the towns of Bavay and Tournay. These cuttings took place on the spot described in the Itinerary of Antoninus as the Pons Scaldis. In the course of the works there have been discovered on various points remains of constructions, and large quantities of material which indicate the site of a town or large village; and it appears that in this locality several bridges have been thrown over the Scheldt. This discovery shows that the point given by antiquaries as Pons Scaldis was not merely a bridge over the Scheldt, but a Roman station which was probably fortified."

Royal Botanic Society

The issue of the *Gentleman's Magazine* of November 1839 contains the following information: "A charter of incorporation has just been granted to this Society, 'for the promotion of botany in all its branches, and its application to medicine, arts, and manufactures, and also for the formation of extensive botanical and ornamental gardens within the vicinity of the metropolis'. The Charter appoints the Duke of Richmond as the first president, Mr. Marjoribanks the first treasurer, and the Duke of Norfolk, the Earl of Albemarle, Mr. Rushbrook, Philip Barnes and James de Carle Sowerby Esqs. the first councillors. The organization is similar to that of other scientific societies, and meetings for the discussion of scientific subjects will be held periodically. The anniversary meeting is assigned by the charter for the first of January. Steps are in active progress for the completion of the gardens in Regent's Park, in which exhibitions will be held in the approaching season."

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in the Mining Department—The Principal, Technical College, Sunderland (November 25).

Sub-Librarian of the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (December 31).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The British Academy. Presidential Address, 12 July 1939, by Sir David Ross. (From the *Proceedings of the British Academy*, Vol. 25.) Pp. 8. (London: Oxford University Press.) 6*d*. net. [2510

Borough of Falmouth Public Library. Descriptive Catalogue of the Paintings and Engravings in the Maritime and General Art Collections. Pp. 28. (Falmouth: Public Library.) 2*d*. [2510

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 129: Investigations on Chilled Beef. Part 2: Cooling and Storage in the Meatworks. By W. J. Scott and Dr. J. B. Vickery. Pp. 68. (Melbourne: Government Printer.) [2310

Indian Forest Records (New Series). Botany, Vol. 1, No. 5: Recently Introduced or Otherwise Imperfectly Known Plants from the Upper Gangetic Plain. By Mukat Behari Raizada. Pp. vi+223–236. 12 annas; 1*s*. Entomology, Vol. 5, No. 3: New Species and Biology of *Coccotrypes* and *Thamnurgides* (Scolytidæ, Col.). By C. F. C. Beeson. Pp. ii+279–308. 10 annas; 1*s*. (Delhi: Manager of Publications.) [2310

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 186: The Pomegranate Fruit Butterfly *Virachola livia* Klug; Morphology, Life-History and Control. By Dr. A. D. Hanna. Pp. ii+54+40 plates. P.T. 10. Bulletin No. 196: Further Tonnage Tests of Imported Sugar Cane Varieties. By Arthur H. Rosenfeld. Pp. 10+2 plates. Mills. 15. Bulletin No. 203: Manurial Requirements of Sugar Cane in Egypt. 3: Further Rate of Nitrogen Experiments. By Arthur H. Rosenfeld. Pp. ii+24+5 plates. Mills. 35. Bulletin No. 209: Some Mealy Bugs of Egypt and Experiments on their Control by means of Chemicals. By M. Beshir and M. Hosny. Pp. 16. P.T. 2. Bulletin No. 216: Some Notes on the Potato Tuber Moth (*Phthorimaea operculella*, Zell.). By Rizk Attia and Bishara Mattar. Pp. ii+136. P.T. 10. Bulletin No. 223: Study and Control of Antirrhinum Rust. By Dr. Amin Fikry. Pp. ii+16+21 plates. P.T. 4. Bulletin No. 226: Pneumococcus in Camels. By Dr. Hussein Kamel. Pp. 12+4 plates. P.T. 2. Bulletin No. 235: The Cottons of Egypt. By H. A. Hancock. Pp. 24. P.T. 2. (Cairo: Government Press.) [2410

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1932–33. English Version. Part 1. Pp. 214. P.T. 50. Part 2. Pp. 438+12 plates. P.T. 100. (Cairo: Government Press.) [2410

U.S. Department of the Interior: Office of Education. Bulletin 1939, Misc. No. 3: Education in the United States of America. Pp. 55. 15 cents. Leaflet No. 52: Know Your Modern Elementary School. By Helen K. Mackintosh. (Know Your School Series.) Pp. iii+22. 5 cents. Vocational Division Bulletin No. 196 (Business Education Series No. 11): Conference Topics for the Retail Grocery Business. Rewritten and revised by Kenneth B. Haas and B. Frank Kyker. Pp. iii+138. 20 cents. (Washington, D.C.: Government Printing Office.) [2410

Proceedings of the United States National Museum. Vol. 87, No. 3069: A Generic Revision of the Staphylinid Beetles of the Tribe Paederini. By Richard E. Blackwelder. Pp. 93–126. (Washington, D.C.: Government Printing Office.) [2410

Memoirs of the Entomological Society of Washington. No. 1: The North American Bees of the Genus *Osmia* (Hymenoptera: Apoidea). By Grace A. Sandhouse. Pp. iv+167 (11 plates). (Washington, D.C.: Entomological Society of Washington.) [2410

U.S. Department of Commerce: National Bureau of Standards. Research Paper RP. 1221: Rate of Oxidation of Steels as determined from Interference Colors of Oxide Films. By Dunlap J. McAdam, Jr. and Glenn W. Geil. Pp. 63+124. (Washington, D.C.: Government Printing Office.) 10 cents. [2410

National Advisory Committee for Aeronautics. Report No. 670: Tensile Elastic Properties of 18:8 Chromium-Nickel Steel as affected by Plastic Deformation. By D. J. McAdam, Jr. and R. W. Mebs. Pp. ii+42. (Washington, D.C.: Government Printing Office.) 15 cents. [2410

New Zealand. Thirteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 134. (Wellington: Government Printer.) 2*s*. 9*d*. [2510

Report upon the Mining Industry of Malaya. By Sir Lewis Leigh Fermor. Pp. xv+240. (Kuala Lumpur: Government Press.) 2.50 dollars; 6*s*. [2610

Royal Observatory, Hong Kong. Magnetic Results, 1938. Prepared under the direction of C. W. Jeffries. Pp. 51+2 plates. (Hong Kong: Government Printers.) 1 dollar. [2710